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In collaboration with the Officers of the Department of Agriculture.

CONTENTS.

(Vol. V, No. 1.)

ORIGINAL ARTICLES.

SELECTED ARTICLES.

REPORTS.

LIST OF ILLUSTRATIONS.

The

Agricultural Journal of British Guiana.

March, 1934.

EDITORIAL.

CO-OPERATION.

The trend of civilization is towards co-operative action. Once it was accepted that man should protect himself on the principle of an eye for an eye. Civilized man has passed beyond that stage, and has set up a co-operative organization—Government—to whom is assigned the power to protect and punish. The time was when each man had to cut his own track or path; now roads are made and maintained by some organization that is financed co-operatively—usually Government—and here, too, individualistic action has been replaced. In former years each farmer did all the experimentation which he thought necessary in connection with the growing, manufacturing and distribution of his crops; but much of this has now become the function of Departments of Agriculture.

An agricultural department is therefore to be regarded as an institution set up in order to serve those who contribute to its support in a manner and in those directions in which circumstances may dictate.

One of the problems that have been exercising the minds of those associated with co-operative organizations is that of justly assessing the work and value of these bodies. If such an organization is to give the best service to those whom it is intended to serve, then the work of that organization must be fully known and, whenever necessary, adequately criticised. But if criticism is to fulfil its purpose—which, presumably, is to improve the service of the co-operative institution to its supporters—then it is necessary that discussion on policy be directed by an intelligent and sane appreciation of values.

It has been the experience of many a co-operative body that those most desirous of its welfare have frequently obstructed the course of progress and achievement when the intention was to help. An example of this may illustrate the point: The history of a well-known Co-operative Association shows that it was formed by a number of growers with the object of marketing their produce.

The aim was to sell directly to consumers through the Association and so reduce middlemen's charges. The Association succeeded for a period and then criticism against the Association began and increased on the grounds that growers who did not belong to the Association were having their produce handled by middlemen at as low a rate as was the charge of the Association. Support of the Association waned. Experience afterwards showed that this attitude was ill advised because events demonstrated that the work of the Association was directly responsible for the better service which the farmers were receiving. The Association had forced competitors to give better prices and so had given valuable help both to members and to the district as a whole.

It is not intended to labour the point further, but experience makes it clear that the efforts of organizations of a co-operative nature are assisted or greatly encumbered according largely to the conception or point of approach of all concerned.

It is generally accepted that one of the best standards by which the value of the service of a co-operative organization can be gauged is the volume, and trend in volume, of the business being done by the organization. Thus, if the volume of business being done by an institution increases from year to year, that will, by generally accepted standards, be regarded as a satisfactory indication. Since it is accepted that an important phase of the business of a Department of Agriculture is directed towards production, then the records of agricultural production and exports of this Colony within the last five years may be regarded with distinct approbation. There is much yet to be done, but if the Agricultural Department is to prosecute those lines of endeavour most pregnant with possibilities for the agricultural development of the colony it is conceived with assurance that those, who interest themselves in our policies, will continue to regard difficulties and achievements in their true and rational perspective.

In these troublous times when this agricultural country of ours must investigate and approach with determination every freshly-arising problem, the Department has striven and is striving to give of its best. We shall maintain our policy which is, holding fast to those industries which are already established, to press towards the development of every minor industry that is economically justified.

With the first issue on the re-appearance of this Journal we desire to convey, to every agriculturist throughout British Guiana, the wish and hope for more prosperous times, nor are the signs lacking that our hopes will be fulfilled. To make our hope a realization we must work together. The Department of Agriculture gives and seeks in return—co-operation.

THE FLOODS.

There is published elsewhere in this number a brief report with photographs of the floods which occurred in January last and which were responsible for severe damage and loss to agricultural industries. A Flood Investigation Committee, of which the Honourable the Colonial Secretary is Chairman and the Director of Agriculture a member, was appointed by His Excellency the Governor to report on

(1) The general effects of the floods ;
(2) The steps to be taken to meet the situation ;
(3) Preventive measures for the future.

Immediate relief measures were adopted in those districts where the damage was severest, and a report of the Committee will shortly be available : it will thus be possible in the next issue of the Journal to give more definite statistical information in regard to the losses suffered by the Colony.

THE INTERIM.

It unfortunately became necessary to suspend publication of this Journal as from December, 1931. The Director of Agriculture, in the last issue, December 1931, wrote :

"This Journal has had to perform very diverse functions. It has been a "useful means of distributing information to local agriculturists, the record of "the work undertaken and conclusions drawn to which most easy reference can "be made, a reciprocating medium between this and other overseas Agricultural "Departments."

The absence of the Journal has, therefore, been felt acutely, and one of the factors responsible for its re-appearance is the numerous requests which have been received by the Department from those engaged and interested in the agriculture of the Colony.

Since the Journal last appeared, the following publications in addition to the annual *Administration* and *Divisional Reports* have been issued from this Department : Leaflets on : *Peas and Beans*, *Grapefruit Culture*, *Beekeeping*, *Witchbroom Disease of Cacao*, *Proceedings of the Second Annual Meeting of the Buxton-Friendship Farmers' Union*; *Moth Borer Damage in relation to Sugar Cane Varieties in British Guiana* (L. D. Cleare, "Tropical Agriculture", September, 1932); *Recent Research on Empire Products in British Guiana* (Prof. J. S. Dash *et al.*, "Bulletin of the Imperial Institute", April 1933); *Flood Fallowing of Cane Fields in British Guiana* (R. R. Follett-Smith, "Tropical Agriculture", April 1933); *Sugar Bulletins Nos. 1 and 2*; *Plant and Seed Exchange List, Botanic Gardens*; *Entomological Bulletin No. 2*; *Rice Bulletin No. 1*; *Sugar Cane Soils of British Guiana* (R. R. Follett-Smith, published for private circulation by Messrs. Booker Bros., Mc Connell & Co., Ltd.)

A number of the incidents which have occurred, and which would have appeared in issues of the Journal, will briefly be mentioned below.

Mr. F. A. Stockdale, C.M.G., C.B.E., Agricultural Adviser to the Secretary of State for the Colonies, visited British Guiana from February 28 to March 15, 1932, "to ascertain the present-day conditions of the agricultural industries and to study the work being performed to assist these industries." In the report on his visit Mr. Stockdale stated, *inter alia* :—"The Colony continues to have its problems—some of them of considerable magnitude. It has, however, attempted to tackle them. Much development has taken place since my former residence in the Colony ; many improvements have been effected in the production of sugar and the thriving rice industry has developed."

The Department has established a Demonstration Apiary primarily for the purpose of acquiring more definite information on practices best suited to beekeeping in the Colony, to help beginners and others interested to see in operation the equipment which is considered necessary in modern beekeeping, and to provide a continuous supply of queens of Italian stock. The results thus far obtained in the distribution of queens are promising. A Beekeepers' Association was organised and held its first meeting on June 6, 1932. The Director of Agriculture at that time stated in connection with the Association : "I consider "this an important minor industry and one which should be encouraged ; it was "for that reason I initiated certain proposals calculated to lead to co-operative "endeavour by beekeepers in the Colony."

The Ordinance to provide for the control of Sugar Experiment Stations was revised in 1932, and, with the approval of the sugar producers of the Colony, the cess to meet the expenses of sugar experimental work was increased to 30c. per acre of cultivated cane land.

In connection with the rice grading regulations further advance was made by the passing of legislation in 1932 to enforce blending of rice for export ; uniformity in each consignment of a particular grade is therefore now ensured. A Rice Marketing Board has been formed and the Director of Agriculture is a member.

A Rice Factories Ordinance was passed in 1933 and makes provision for the regulation and control of rice factories with special regard to licensing, building sites, sanitation, weights and measures, and the keeping of proper records.

A Copra Brokers' Board has also been formed. Further reference to this is made elsewhere in this Journal.

A party of post-graduate students of the Imperial College of Tropical Agriculture under the charge of Sir (then Mr.) Geoffrey Evans, Principal, visited the Colony from March 26 to April 3, 1933. The students thus gained first-hand

information on the work being done by the Department and the lines on which the agricultural industries of the Colony are organised. His Excellency the Governor, Sir Edward Denham, addressed the students on "Imperial Agriculture in relation to Government Service."

The large scale experiment with pineapples by the British Guiana Pineapple Company is proceeding, and full co-operation is being given by the Department to this Company to ascertain definitely the possibilities of this industry under local conditions.

Five prizes were awarded British Guiana padi at the World's Grain Exhibition held at Regina, Canada, in 1933. These padis were all of the ordinary commercial run from various districts of the Colony and are typical samples of the raw product from which the higher grades of rice now being exported from the Colony are milled. With assistance from the Colonial Development Fund a rice mill has been erected principally for demonstration in white rice production and to enable an economic study of the manufacture to be made under British Guiana conditions. Excellent samples of this class of rice have been turned out and favourable comments received from the trade.

The West Indian Intercolonial Fruit and Vegetable Conference was held in Jamaica from October 17 to 24, 1933. The object was "that the present position of the West Indian Fruit and Vegetable Industry might be reviewed and consideration given to the formulation of a co-ordinated policy." The Director of Agriculture represented British Guiana at this Conference, a report on the recommendations and proceedings of which has since been published.

SUGAR-CANE RESEARCH IN BRITISH GUIANA, 1929-1933.

BY

PROFESSOR THE HON. J. SYDNEY DASH, B.S.A.,

Director of Agriculture.

INTRODUCTION.

At the present time when consumption and production in the world's sugar industry are unbalanced it might seem that expenditure on research was unjustified. It might be said that methods for increasing sugar production are not so important at the present juncture and that research should be directed entirely towards the exploration of new outlets for the final product. Such an attitude is untenable in view of past experience. Wise industries and communities have always in times of financial distress redoubled their research activities. The Imperial Department of Agriculture, which proved its great utility to the West Indies, was the outcome of the recommendation of a Royal Commission initiated as a result of a depression in the sugar industry. Field research to-day must aim at showing the planter how to obtain the same or greater yields at lesser cost.

The sugar work of the Department of Agriculture was re-organised in 1928-1929, and the writer, assisted by a committee of planters, assumed control of the Sophia Sugar Experiment Station. It seems desirable at this stage to review the progress achieved during these five years under the new *regime*. A short description of the work accomplished by the staff of the Station in collaboration with the officers of the Department is therefore presented. Details of these results have been given in progress reports submitted from time to time to the Sugar Producers' Association and have appeared in various Departmental publications, a list of which is given at the end of this article.

SUGAR-CANE VARIETIES.

It was found that a large number of imperfectly tested seedlings had accumulated at Sophia. It had been the policy in the past to permit the extension of canes, of promising appearance but with little field history, to the plantations of the colony where further testing was made on a commercial scale. This policy did not appear to meet with much success. Canes possessing good appearance, due possibly to intensive cultivation at the station, failed, on some score or other when extended to the estates. Furthermore the station staff lost touch with the performance of the seedlings. It seemed wise therefore to limit severely the extension of partially tested seedlings of promising appearance to

the estates and to establish chains of well-designed experiments with the better seedlings found at Sophia at various centres on the sugar-cane areas of the Colony. This policy has been followed during the last four years and, besides thoroughly testing the legacy of seedlings at Sophia, certain imported canes have been given extended trial. There are at present fifty-one variety trials scattered along the Colony's cane belt and, in addition, eight of the earlier experiments have yielded all the information expected of them and have been discontinued. In these trials 105 seedlings were rigidly compared with the standard cane, D. 625, and information has been obtained which leads to the elimination of at least 75 per cent. of these seedlings. The position may be summarised in the following terms :

P.O.J. 2878 and Diamond 10 have appeared in numerous plant cane and first ratoon trials and undoubtedly outyield D. 625.

D. 666/18 and P.O.J. 2727 have been thoroughly tested and are at least equal to, if not better than, D. 625.

D. 11/28 shows outstanding promise as a plant cane and appears in other trials shortly to be reaped. Its ratooning powers will be watched with interest.

Promising canes worthy of further trial are :—D. 747/13, C.O. 213, D. 447/17, C.O. 281, C.O. 210, P.O.J. 253, D. 927/22, D. 207/20, D. 628/21, D. 195/17, D. 857/21, D. 11/24, D. 241/21, S.W. 3 and D. 173/21.

Although this list contains a considerable number of canes imported sincel 1929 (P.O.J. and S.W. seedlings from Java and C.O. seedlings from India) it wile be noted that none of the canes mentioned have been *bred* in this colony sincd 1929. This fact is not surprising when it is remembered that the breeding an- establishment of a new seedling takes some considerable time. The new breed, ing work commenced in 1929 and, during the period under consideration approximately 37,800 seedling canes were evolved.

SEEDLINGS BRED AT SOPHIA EXPERIMENT STATION.

1929	6,000	
1930	9,235	
1931	4,210	
1932	5,290	
1933	6,791	(6,209 still in boxes)
	31,556	

Selected canes of the 1930 batch were placed in preliminary field trials at Sophia during the latter half of 1933 and plant cane results should be available at the end of the present year. Perhaps the most important attribute of a successful seedling in this colony is its vigour as a ratoon. Information regard- ing the ratooning capabilities of the 1930 seedlings in the preliminary trials now

in progress will not be available till the end of 1935. In the meantime; the 1930 seedlings, which give heavy plant cane crops at Sophia will be extended in field trials at various outside centres during 1935 and these trials will furnish information regarding their first ratoon crops in 1937. It will be seen, therefore, that from the time of breeding it takes some seven years, at least, of ceaseless experimentation and selection before any definite information can be obtained regarding the suitability of a seedling to local conditions. The production and testing of seedlings is a time-consuming occupation and requires essentially a continuity of policy. Unfortunately the early years of the Station's existence were marked by periodic changes in organisation. The work completed during the more recent years under review can be regarded with satisfaction. During this period 59 field trials embracing 105 seedling canes have been established while the number of samples of cane analysed in connection with variety and fertiliser trials during the period is 5,598. As a result of this work the Department is able to indicate two seedlings which undoubtedly outyield the standard variety, two canes which are at least equal to the standard and which would prove extremely useful if D. 625 failed. In addition there are 16 seedlings which show considerable promise and deserve further field trial together with a number of West Indian canes collected by the Agronomist during a tour of the Caribbean. These latter canes have recently been released from quarantine and are established in preliminary field trials. The seedlings obtained prior to 1929 were mainly the result of crosses between local canes. There is reason to believe that most useful combinations of these varieties had been exhausted. Breeding since 1929 has involved the crossing of promising local canes with imported canes of considerable merit and should be attended with success.

SUGAR-CANE SOILS.

During 1929 the soil investigational work of the Department was entirely confined to surveys of the interior of the colony. The attention of the Chemical Division turned to cane soils in 1930 and a considerable amount of advisory and research work was completed during that year. During 1931 Messrs. Booker Bros. McConnell & Co., Ltd. provided funds for a detailed soil survey of the estates in their connection. This survey which covered 34,617 acres and entailed the collection and detailed examination of 5,786 soil samples, was completed during 1933. The survey has provided information of very considerable value to the estates concerned and has indicated the nature and location of necessary field experiments with fertilizers. The survey has stressed the importance, in some areas, of the pegasse soils. Hitherto the requirements of such soils as regards cane varieties and differential manurial treatment had not been considered. These requirements are now being investigated. The survey has also proved that marked changes have taken place in the soils during the last two decades and that revision of the extended fertilizer experiment of Sir John Harrison are necessary.

In addition to soil survey work a considerable amount of research, particularly concerning the mechanism of flood-fallowing, has been undertaken. This work has indicated that flood-fallowing not only removes considerable quantities

of harmful salts from the soil but is actually responsible for an increase in the amount of ammonia in the soil. More recent work which requires, and is receiving, amplication suggests that interesting alterations in the organic matter and other constituents of the soil are consequent upon flood-fallowing. This phenomenon is also receiving attention in two series of field trials. One series is designed to compare the effects of different periods of immersion and of application of limestone before and after flooding. These experiments include plots submerged for twelve months, eight months, four months and certain plots not flooded at all. The time factor is of considerable importance to those estates where there is little or no room for extension of cultivation and where adequate supplies of water are not always available. On the basis of field observation it is generally considered that submergence for less than four months produces no beneficial results and may, in fact, be detrimental. It is also felt that longer flooding periods are to be preferred and immersion is continued for two years in some cases. Definite information concerning the optimum period of submergence will be of very considerable interest to a large number of estates. The other series of experiments compares the effects of different depths of flooding of the admixture of final molasses with the flooding water and of the encouragement of the growth of water plants. It is held that the depth of the flooding water has a marked effect on the subsequent yields and many estates go to considerable expense in raising dam beds and in pumping large amounts of water in order to keep up a depth of twelve inches.

SUGAR-CANE FERTILISERS.

The informative fertiliser experiments carried out by Sir John Harrison during the first two decades of the present century placed the fertiliser programme of the colony's sugar estates on a firm basis. Neighbouring West Indian colonies have for a great many years spent considerable sums on the preparation and application of pen manure and other organic fertilisers. These colonies have recently obtained field evidence showing that applications of artificial manures are just as effective and considerably cheaper. Sir John Harrison demonstrated the pre-eminence of sulphate of ammonia in this Colony many years ago. Recently there has been considerable discussion in sugar circles as to whether the industry has been wasting money on fertilisers. Such a charge cannot be laid at the door of the planters of this colony who have, if anything, erred on the conservative side where applications of fertilisers are concerned.

The recent detailed soil surveys demonstrated that considerable changes have taken place in the colony's cane soils since Sir John Harrison conducted his experiments. Moreover the fertiliser requirements of the pegasse soils, had, hitherto, never been investigated. It was apparent that a chain of fertiliser trials in areas selected in the light of the soil survey was an urgent necessity.

Although progress has not yet reached a stage where more than tentative conclusions can be drawn, certain results from recent experimental work have been obtained which deserve special reference here. The investigations of

twenty to twenty-five years ago showed that the frontland clay soils were definitely alkaline; most of these at the present time are acidic. This change is probably due to the continuous application of sulphate of ammonia and the removal of alkaline salts by drainage and flood fallowing. On this basis, therefore, liming is indicated. Thus far, field liming experiments on the frontland clay soils have not given encouraging results although the effects of lime on soils cannot be judged by the results of a few crops only. Nevertheless, as there is a progressive change towards acidity, the time may arrive when the growth of the cane may be materially affected, and there seems to be little doubt that liming is justified. In the past, slaked lime was used, but ground limestone would appear to be well deserving of consideration, since it is equally effective and has the advantage of being cheaper to apply and easier to handle. In regard to the pegasse soils, results at present indicate that small applications of lime are financially sound.

Sulphate of ammonia is the most generally used source of nitrogen in the Colony, but the practice of flood fallowing appears materially to affect the amount of this fertilizer required. Trials indicate that on frontland clays, which have been flood fallowed, applications of 2 cwt. of sulphate of ammonia per acre of plant canes and 4 cwt. per acre of ratoons should be made. Fields not flood fallowed should receive heavier dressings, *e.g.*, 4 cwt. per acre for plant canes and an equal dressing for ratoons. The indications of trials to date show that even heavier applications are required on the pegasse soils and that dressings of 6 cwt. may economically be justified.

Further experiments are in progress especially as Messrs. Booker Bros., McConnell & Co., Ltd., and the Imperial Chemical Industries, Ltd., have provided funds for the establishment of a number of additional fertilizer trials with nitrogenous and phosphatic manures. The majority of these latter experiments will be reaped during the present year, though one or two of them will, unfortunately, be vitiated by the recent inundations.

It should be mentioned that the method employed at the Station of analysing samples of cane from each plot of each experiment and the subsequent statistical examination of the figures for juice purity, glucose ratio and sucrose content of the cane preclude any danger of recommending dressings of nitrogenous fertiliser sufficiently heavy to impair the quality of the cane.

SUGAR-CANE PESTS AND DISEASES.

In recent years the major insect pest of the colony's cane cultivation is the moth-borer (*Diatræa* spp.). It has been estimated that 90 per cent. of the cane stalks and 20 to 25 per cent. of the joints are affected by the ravages of this insect. It is estimated that this pest involves an annual loss of at least 10 per cent. of the sugar crop of the Colony. Investigational work carried on during the last two and a half years with the aid of special grants from the Colonial Development Fund has shown that different varieties of cane show differing degrees of

susceptibility to attack. Canes of local parentage appear to be more attractive to the insect than do imported varieties. The present breeding policy of the Station, involving as it does crossing between promising local and imported canes, is therefore well founded.

During 1933 a special grant from the Sugar Producers' Association made possible the collection from the river Amazon of a promising parasite and its introduction into this colony. The parasite has been multiplied in the laboratory at the Station and has been released at several points on the sugar-cane belt. Evidence is forthcoming that these released parasites have completed a life-cycle in the field. There is therefore promise that the damage due to this pest will be considerably reduced in the future. Further reference to this work is made elsewhere in this issue.

In recent years the attacks of "white grubs" or "hardbacks" have become more prominent. The problem is discussed in an entomological bulletin (*Entomological Bulletin No. 2*) recently published by the Department. It is suggested that the number of outbreaks has increased since flood-fallowing came into practice and that the time is not far distant when it will be necessary to conduct an extended investigation on these insects with a view of undertaking biological control.

Increasing prevalence and severity of outbreaks of cane lice (*Sipha flava*) has caused the Department to undertake a study of this pest.

Sugar-cane in this colony is singularly free from diseases although the cultivation in the adjoining colony of Dutch Guiana is affected by mosaic disease. In certain areas, mainly confined to the Berbice estates a "root disease" or "dead heart" is at times conspicuous. This disease was attributed in certain circles to the presence in the soil of an unfavourable ratio of magnesia to lime. Recent work by the Department indicates that excessive amounts of sodium salts in the soil may bring about a similar affection.

Agricultural Practice.

There are many aspects of cane agriculture in this colony which deserve extended experimental work, yet funds are not available for such investigations. Drainage is perhaps the most important single factor affecting cane growth in British Guiana. Without good drainage other improvements (such as new varieties and better manurial practice) are insignificant and hardly worth considering. Irrigation has done much towards improving the yield of several estates of the colony. Tillage is a factor of considerable importance on the heavy, impervious, saline clays of British Guiana. An experiment station should be in a position to produce data from actual field trials concerning drainage, irrigation and cultivation. At present our limited resources do not permit investigations in these important branches of cane husbandry.

Summary.

It will be seen that the Department since its re-organisation has maintained a well-balanced research programme in spite of its slender resources. There is in some quarters a tendency to over-estimate the importance

of variety breeding in comparison with other branches of the work. It is advisable to make sure when a greatly improved variety is bred that the cane soils of the colony are in a fit state to support it, that insect pests are reduced to a minimum and that a rational system of manuring is in vogue. That so much work has already been done is due, in no small measure, to grants of financial assistance from the Empire Marketing Board, the Colonial Development Fund, Messrs. Booker Bros. McConnell & Co., Ltd., Imperial Chemical Industries Limited and the British Guiana Sugar Producers' Association.

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(18) Variety Experiments with Sugar-Cane by C. H. B. Williams (Vol. IV, No. 4).

V. Sugar Bulletin No. 1.

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SUGAR-CANE MOTH-BORER INVESTIGATIONS IN BRITISH GUIANA: THE PRESENT POSITION.

BY

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Sugar-cane Moth-borer Investigations, British Guiana.

The Sugar-cane Moth-borer Investigations in British Guiana which are being undertaken under a grant of the Colonial Development Fund are part of the general West Indian Investigations on entomological problems of the Imperial Institute of Entomology under the supervision of Dr. J. G. Myers.

The West Indian investigations embrace a number of projects concerning different insects affecting several crops, and include such major entomological problems as the Froghopper in Trinidad, the Citrus Black Fly in Jamaica, and the Sugar-cane Moth-borers in Antigua and British Guiana.

As the result of representations made to His Majesty's Secretary of State for the Colonies, funds were granted from the Colonial Development Fund to undertake investigations into the ecology and means of control of the sugar-cane moth-borers in the West Indies and British Guiana, and the island of Antigua in the Leeward group of the British West Indies, and British Guiana on the mainland of South America were selected as suitable places to carry out the work. Two entomologists were selected to be in charge of the investigations—Mr. Harold E. Box in Antigua and Mr. L. D. Cleare in British Guiana—and work commenced in April 1931 in Antigua, and in July 1931 in British Guiana.

The reason for the selection of these two colonies for the investigations on sugar-cane moth-borers was the different conditions offered by them. In Antigua, with its dry climate, but one species of moth-borer, *Diatraea saccharalis* (Fabr.), occurs and is attacked by insect parasites only in the egg stage, namely, the well known Yellow Egg-parasite *Trichogramma minitum* Riley, and the Black Egg-parasite, *Prophanurus alecto* Cwfd. In British Guiana, with its high rainfall and humidity, there are, on the other hand, two species of moth-borer of common occurrence in the cane fields, *Diatraea saccharalis* (Fabr.) and *Diatraea canella* Hmpsn, and on these some sixteen parasites occur including parasites of the egg, larval, and pupal stages. Thus the two countries offer extremes in ecolgical conditions—in Antigua comparatively simple, in British Guiana complicated and diverse—and it is believed that by studying these extremes much information of value and a practical nature will be secured.

The sugar-cane moth-borers (*Diatraea* spp.), or small moth-borers as they are called in this Colony, are the most damaging pests of this crop taken over the West Indies and British Guiana, and are responsible for a loss in these Colonies amounting to several millions of dollars annually. The control of these insects has been a problem for many years, and considerable sums of money have been expended in attempts to combat the pest. The principal, and for many years the only, means of attack against these insects has been the hand collecting of the "borers" by gangs of labourers without very marked effect on the pest.

In 1921 the rearing and utilization of egg-parasites as a means of control was commenced on one estate by the writer, and afterwards was adopted also on another estate. Recent investigations of Dr. Myers have shown, however, the inadequacy of this method of control, and at the same time have pointed to the possibilities of employing larval parasites for this purpose. Dr. Myers's investigations also showed the necessity of general ecological work on these insects.

In planning the investigations on sugar-cane moth-borer for these colonies, therefore, it was the aim of a very large part of the work to obtain information on the general ecology of these insects to fill in gaps in our knowledge which were of importance in the future work of controlling the insect, especially in relation to the employment of parasites for this purpose. It was likewise part of the undertaking to collaborate in the introduction of parasites into the Colony for the purpose of controlling moth-borer, and when introduced to carry out the rearing of such parasites and their distribution to sugar estates.

The purpose of the present paper is to give a short account of the work undertaken on these projects up to the present time and the conclusion to be drawn from it. It is not intended as a complete scientific account of the investigations and should not be considered as such; such an account will appear at a later date.

LABORATORY AND EQUIPMENT.

As no suitable accommodation was available at the commencement of the investigations it was necessary first to erect and equip a small laboratory, the cost of which was met from a portion of a free grant made by the Empire Marketing Board to the Colony of British Guiana for the purpose of sugar-cane research. The laboratory was erected at the Sugar Experiment Station at Sophia, near Georgetown, in proximity to the other buildings on the station after consultation with the Sugar Experiment Stations' Committee.

The laboratory as first erected was 37 feet long by 17 feet wide, of wood framing and concrete stucco panels, raised on concrete pillars 3 feet high: a part of the building measuring 10 feet by 17 feet being screened and fitted as an insectary. Recently the insectary position of the building has been extended by 10 feet in length, the cost of this extension being met from funds of the Sugar

Experiment Station. Amongst the equipment purchased were two Zeiss Microscopes—one Greenough Stereoscopic Dissecting and one compound Stand E Microscope.

MOTH-BORER DAMAGE AND SUGAR-CANE VARIETIES.

Among the first series of investigations undertaken was an inquiry into the relationship of moth-borer damage to sugar-cane varieties. This was made possible by the reaping of a number of variety trials which was being carried out by the Sugar Experiment Station when the moth-borer work commenced, and advantage was taken of the opportunity thus offered. V

This work yielded interesting results immediately and pointed to a definite relationship between moth-borer damage and variety of cane. From the results of the examinations it appeared also that seedling canes could be grouped to some extent at least as regards moth-borer damage according to their parentage, and there was the indication that the "resistance" of seedlings to attack by these insects was a character capable of transmission.

A preliminary account of this work was published in Tropical Agriculture, Vol. IX, No. 9, 1932.

More recent work has shown that this "resistance" is due, in all probability, to the fibrous content and its arrangement in the cane, and this is being further investigated.

MOTH-BORER DAMAGE.

Although a number of estimates have been made of the damage caused by this pest to the sugar industry in this Colony it was considered that all such estimates left much to be desired, in the sense that the damage as regards what might be termed "the field loss" was not taken into consideration. Estimates of the percentage of joints bored by *Diatraea* were the figures usually given in stating damage caused by these insects, but it was known also that there were other factors which were not considered, and consequently were unassessed. Accordingly it was planned as part of investigations, to carry out a series of examinations for the purpose of obtaining a better idea of the extent of damage inflicted by these insects and the ability or otherwise of the plant to meet such damage either by a regeneration or recovery.

For this purpose four fields of cane, two fields of plant canes and two fields of second ratoons, were selected for examination, one of each group being situated on the Sugar Experiment Station and the other on a sugar estate. Monthly examinations were made of each field in order to obtain the damage at different stages of growth and a final examination made just before the field was reaped.

These examinations produced much interesting and unexpected data but space prevents us from dealing fully with it here. Nevertheless it may be stated that at the time of reaping the average of the four fields showed that the number of stalks per stool was 10.3 and of these only 6.3 were living (61.4 per cent.) Of the living stalks 52.5 per cent. were young and unjointed, while of

the remaining 47.5 per cent. of stalks that were jointed, from 84.4 to 100 per cent., with an average of 94.6 per cent., were bored by *Diatraea*, and from 10.6 to 23.2 per cent. of the total number of joints, with an average 15.7 per cent. Further, of the dead jointed stalks 82.0 per cent. were killed by *Diatraea* and these comprised an average of 14.0 joints. The data showed also that this high *Diatraea* damage occurred throughout the entire period of growth of the cane.

Loss Caused by Moth-borer.

While the damage caused by these insects may be gauged with some accuracy it is difficult to estimate what is the actual loss caused in terms of sugar and money. It is a comparatively simple matter to obtain a figure which represents the difference in sucrose between bored and unbored canes and canes in which there is a known degree of boring as represented by the percentage of joints damaged, but any such figure although in itself convincing enough of the importance of the loss caused by the pest, is in reality but a part of the actual loss inflicted.

In this direction also an attempt has been made to obtain data that may be looked upon as more approximate of the true loss caused by *Diatræa* to the sugar industry of British Guiana.

Taking first the loss in sucrose due to moth-borer damage, as the result of a series of analyses covering eleven varieties, it has been found that the loss directly due to this cause averages 1 per cent. sucrose in cane, and in the variety D.625, the standard cane of the Colony, was 1.43 per cent. sucrose in cane.

The average sucrose in cane for the colony may be taken as about 11 per cent. so that such a loss represents slightly more than 9 per cent. With a crop of 148,000 tons for British Guiana this would be equivalent to 11,918 tons of manufactured sugar and at $40 per ton would be valued at $476,720*—and this annually. The figures are based on the crop of 1932 with an output of 148,000 tons commercial sugar. taking 11 tons of cane for a ton of sugar and a sucrose recovery of 78 per cent.

The above is the factory loss caused by a direct loss of sucrose only; the loss caused through the reduction of purity of the juice, and increase of fibre, from this source has not been taken into consideration.

There are other directions also in which moth-borers inflict a monetary loss. These may be called "the field loss", and here unfortunately it is not so easy to arrive at a figure. It has been shown previously that at the time of reaping of the fields of an average of 10.3 stalks per stool only 61.4 per cent. of the stalks were living and that 52.5 per cent. of these were young and unjointed, while 38.6 per cent. stalks were dead of which 64.6 per cent. were jointed. To put this in an-

Note.—*We do not concur with the figures indicating monetary value of losses in this article, since f.o.b. prices are the basis of the calculation and no provision is made for manufacturing costs. This, however, in no way detracts from the substantial loss to the industry as shown by these investigations.—Ed.

other way, we may say that of a total of 10.2 stalks per stool at reaping there were only 3.0 living, jointed and reapable stalks, with 1 dead but reapable jointed stalk and 1 unreapable jointed stalk per stool. The data obtained from these examinations revealed also that this damage was almost entirely due to moth-borers.

It is, of course, impossible to say what number of stalks would have been produced had there been no moth-borer attacks in the canes, but it is evident that they would have been considerably greater. At the same time we must not fall into the error of assuming that each stool would have produced the full number of 10 stalks. Other factors must be taken into consideration such as the number of stalks which can be supported by a given area, as an acre or row of canes. Even allowing that at the present time our cane fields support the maximum number of stalks, if we had an increase of even a third of the number of stalks per stool there would be a corresponding reduction of the number of stools of cane, and it would follow naturally that there would be a greater distance between "tops" when planted, which would be reflected in a reduction of planting material and labour costs. One can only think that it was, unconsciously perhaps, but nevertheless, as the result of moth-borer damage that the present system of close planting has been evolved.

Another direction in which moth-borer inflicts serious field loss, and which it is difficult to form even an idea of what such loss means in money, is in the harvesting of immature cane or the delaying of reaping of the crop. In their attacks on sugar-cane, as is well known, one of the principal forms of injury inflicted by these insects is the destruction of young shoots, and the formation of what are known as "dead hearts." When thus injured by moth-borer such shoots die, and the plant in order to continue its growth must send up new shoots from the stubble below ground. The first and obvious loss due to such injury is the retarding of the general growth of the field for a period corresponding in each stalk to the age of the one destroyed, and if such damage is extensive it may delay the growth of the crop several weeks, depending on the age of the shoots destroyed, with a consequent immaturity of the canes at reaping or postponement of the period of reaping.

The above example deals with a simple instance of attack and a regeneration by the plant, but it is well known that under actual field conditions this seldom occurs and the usual state of affairs is, more often than not, two or three or more such cycles of attack and regeneration.

Yet another and very important way in which moth-borers inflict serious field loss is by reducing the ratooning period of the fields. Apart from any question of irregularity due to shoots of different ages occurring as a result of attack and the accentuation of this irregularity of growth and maturity by different cycles of attacks, the ratooning ability of the plant is also affected. The production of shoots by a cane plant is accomplished by the growth of buds or "eyes,"

and in order to do this the stalk must have reached a stage of development when buds are produced. In young shoots, this stage of development is often not reached before the moth-borers destroy the shoot; the result is that there is nothing below ground as regards that particular shoot that will allow of the continuation of growth. It will be apparent at once that where the destruction of young shoots has been extensive, either in plant fields or ratoons, the ability of the plant to reproduce further shoots is considerably impaired, and the ratooning period and consequent life of the field reduced accordingly.

In estimating the loss caused through these insects one must include also the amount of money expended in trying to combat them. The money spent in this direction varies considerably on estates in the Colony and while there are some estates on which only a few hundred dollars are spent, there are others again on which as much as four or five thousand dollars are expended annually in this manner. It is probably no exaggeration, however, to estimate a cost of fifty cents per acre for this work throughout the Colony, and with approximately 60,000 acres under sugar-cane, we arrive at an expenditure of $30,000 in this direction annually.

With a direct factory loss of approximately 9 per cent. and taking into consideration the field losses as mentioned above, it has been estimated that the entire loss caused to the sugar industry of British Guiana by sugar-cane moth-borers (*Diatraea* spp.) amounts to from 15 to 20 per cent. of the crop. Based on a crop of 148,000 tons this would be equivalent to from 22,200 to 29,600 tons sugar which at $40 per ton would be valued at from $888.000 to $1,184,000 every year.

CONTROL MEASURES.

We may now consider the control of these insects in the light of work done in the past and the possibilities of the future.

The method of control adopted in the Colony up to the present time, as already stated, has been principally hand-collecting, both as egg-collecting, that is the removal of the egg-masses from the plants with small pieces of leaves on which they occur, and larva-collecting or "cutting-out borer" as it is generally called, which is performed by "cutting-out" of the "dead hearts" containing moth-borer larvæ or pupæ, and their removal therefrom and subsequent destruction.

Among the projects of the present investigation are a series of éxperiments to prove the efficiency or otherwise of these methods of combating the moth-borer. Experiments have been carried out in this direction both as regards egg-collecting and "cutting-out borer," but from the data obtained it is not possible at present to make any definite statement on this point.

INTRODUCTION OF THE AMAZON FLY.

The other part of the investigation, namely the collaboration with Dr. Myers in the introduction of such parasites as were considered suitable for the Colony was

delayed until recently owing to the fact that no parasite which was considered promising for British Guiana had been found by Dr. Myers in his explorations.

Although a number of parasites were known to attack moth-borers, and the Cuba fly, *Lixophaga*, had been introduced into Antigua and St. Kitts, none of these were thought suitable for introduction to British Guiana.

About the middle of 1932, Dr. Myers, while working in the Amazon region, discovered an entirely new and very curious fly parasite on the small moth-borer which he considered suitable for introduction to this country. This fly has been named *Metagonistylum minense* but may be popularly called the "Amazon Fly". On his return to this Colony in January 1933 Dr. Myers communicated his discovery to the British Guiana Sugar Producers' Association, and pointed out the desirability of introducing the insect into the British Guiana cane fields. The Association thereupon voted funds to the extent of £2,000* for the introduction of the insect at the earliest date that Dr. Myers considered suitable.

In accordance with this, Dr. Myers with Mr. L. C. Scaramuzza as assistant, left Georgetown for the Amazon district in April 1933, travelling through British Guiana, taking with him a launch specially imported for the work. Owing to the innumerable difficulties encountered on this journey, including the overturning and sinking of the launch in Gold Fall on the Essequibo River, the Amazon region was not reached for some two months, only to find that recent legislation of the Federal Government of Brazil had prohibited scientific expeditions except under very restricted conditions, and a further delay of a month ensued.

Three months were spent by Dr. Myers at his base at Santarem, on the Amazon, studying the life requirements of the parasite, experimenting with the means of transport for the 1500-mile journey, and in shipping the parasites to Georgetown. From Santarem the parasites were sent by special launch to Para, thence by Pan-American Airways to Georgetown.

In all six shipments of the parasite were sent to the Colony, the first arriving at Georgetown on 30th August, 1933, and the last on 31st October, 1933.

At this stage it may be of interest to give some account of the bionomics of the fly and the methods of rearing it. It must be pointed out first that the insect is essentially a parasite of small moth-borers, *Diatraea*, and as far as is known does not attack any other insect. It is, of course, quite incapable of inflicting any damage to sugar-cane itself in any form of its existence.

The insect is a true fly belonging to the same order of insects (Diptera) as the common house-fly. It is usually somewhat larger in size than the house-fly, in fact in well developed specimens it is nearly twice the size of that insect, but its size varies somewhat according to the amount of food available during its development. In its habits also it is different from the house-fly in this respect being closer to the "blow-fly" to which it is nearer related. By this is meant

NOTE.—*This £2,000 was placed for purposes of control at the disposal of the Sugar Experiment Stations Committee of which the Director of Agriculture is Chairman. Co-ordination of the general sugar policy of the Department with the wishes of the industry was thus assured.—Ed.

especially the method of reproduction in which living maggots are deposited which develop from eggs within the female.

When a gravid female of the parasite discovers in the cane field a young shoot or stalk in which is situated a moth-borer larva it deposits maggots at the entrance of the tunnel of the borer. When thus deposited the maggots are about $\frac{1}{30}$th of an inch in length, and can be seen with the naked eye with difficulty. The maggots thus deposited, directed either by smell or reacting to some other stimulus, possibly the darkness of the boring, enter the borer tunnel and eventually one or more find their way to the *Diatraea* larva.

Having once attained the moth-borer larva the maggots are not long in boring their way inside, where development takes place. The moth-borer larva continues to develop normally for some days after the parasite maggots have gained entry, but as the maggots within it develop and more important organs of the host are attacked and their functions interfered with the moth-borer larva becomes more sedentary and incapacitated until eventually it succumbs.

By this time, if the *Diatraea* larva was in the first instance of a sufficient size to support the feeding parasite maggots the development of the latter would be completed as far as the maggot stage is concerned, and they leave the now mere remains of the moth-borer larva. If development has been normal the parasite maggots would have grown very considerably during this period. The parasite maggots now undergo a change and become hard dark brown elliptical "puparia," varying in size according to the maggots which preceded them, and in well developed specimens may be $\frac{5}{16}$ inch in length. A period of about eight days is spent in this stage after which the adult flies emerge.

From the deposition of the maggot by the parent fly to the emergence of the fly of the next generation requires a period of some fourteen days. A few hours after the emergence of the flies mating of the sexes occurs. After a period of gestation of between six and seven days the female fly is ready to deposit maggots for the commencement of another generation.

For the rearing of the fly in the laboratory, gravid females are dissected and the living larvae obtained are placed by means of a fine sable-hair brush on *Diatraea* larvae, which they enter and undergo development in the manner explained above. The *Diatraea* larvae artificially infested are kept in the cane shoots for a period long enough to allow of the development of the parasite larvae into puparia and are then examined, and the puparia removed. The puparia so obtained are then placed on damp bagasse in bottles for the emergence of flies, which are subsequently mated and, when ready to deposit larvae, liberated in the cane fields.

Up to the present, the parasite has been released on five estates in the counties of Demerara and Berbice, namely, Plantations Lusignan, Non Pareil, Enmore, Providence (East Bank) and Albion, as well as at the Sophia Sugar Experiment

Station. At each of these places the parasite has since been recovered working in the fields and on those estates where the early releases were made the parasite has undergone several generations in the fields. The parasite has withstood both the very unusual conditions of flooding experienced during December 1933 and January this year, as well as the dry and adverse period that has followed, and appears to be very suited to conditions in British Guiana. Arrangements have been made to commence rearing the parasite in field laboratories on several sugar estates.

CITRUS CULTIVATION IN BRITISH GUIANA.

BY

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EARLY RECORDS.

The Citrus fruits, and in particular Oranges, were introduced to the colony, as to the West Indian Islands, by early settlers. Towards the end of the last century when a Botanic Station, the origin of the Department of Agriculture, was started on the lines of similar institutions throughout the West Indies, orange and grapefruit trees were cultivated on most of the estates, and fruit of very good quality was to be obtained.

Early references to this citrus made by G. S. Jenman, the first Government Botanist, and Superintendent of the Botanic Gardens, mentioned the delicious flavour of the best local trees, and he remarks especially on the excellence of the Tangerines. From the outset, the Gardens began to collect seed from the better trees, and in 1883 some grafted orange plants were obtained from England. A later report lists some of the imported oranges grown in the Gardens (Circassian, Botelha, Embignon or Navel, Exquisite, Hampton, Mrs. Markham, Sustain, Thin rinded St. Michaels, White, Native, Creole), but remarks that they are no better than the local seedlings for the table.

The very slow growth of orange seedlings at the Gardens is stressed on several occasions, and also the liability of the citrus trees to be attacked by scale. The report of 1900–1901 alludes to the importation of some Washington Navel Orange plants from the United States Department of Agriculture, in exchange for sweet Cassava varieties.

Three or four years later, after further reference to the previous difficulty of raising seedlings at the Gardens, a greater measure of success was reported to have been achieved as a result of using specially prepared soil and sheltering the young plants. Even so, attempts at budding met with repeated failure, and introduced grafted plants, of which a number were obtained about this time from Trinidad, grew very slowly at the Gardens. It having been observed however, that Lemon and Lime trees throve better than Sweet Orange in the poor soils of the interior, some grafts of Sweet Orange on Rough Lemon stock were sent to one or two localities inland. What results were obtained however, are not recorded.

In the Report for 1912-13, specimens of Parson Brown and Navel are noted as heavy croppers, and two other varieties, Ruby Blood and Boone's Early, are also mentioned. A few years later a big demand for seedling orange plants is recorded, and a number were raised from seeds from Haags Bosche, on the East

Bank. Orders were also being received at this time for grafted plants, but the slow growth of the stocks and the difficulty experienced in propagation made it impossible to fulfil the demands.

Limes, which seem to thrive in the colony under very diverse conditions, have been grown successfully in several areas on a commercial scale. Sometimes plantations have been laid out on the lines usually followed in other countries, the trees being grown in the open and well cared for. In other instances they have been grown under planted shade trees and proved very successful, and cases have been seen also, in the North West District, of abandoned Lime fields, where Limes and bush have grown up together, and the former continued to remain healthy and bear plenty of fruit.

It is on the laterite hills of the North West District that the best Limes are grown at present, trees on the coastal clays being smaller in comparison and bearing lighter fruit. The sand reefs of the coast however, prove a suitable site for Limes.

The existing Lime cultivations to-day are free of serious disease, but the former cultivation of Plantation Agatash near Bartica was affected by Wither Tip, the high humidity of the site being a contributory factor.

The recent synthetic production of citric acid has however handicapped the market for Lime products, and although there are possibilities of small markets for fresh Limes, it was recommended at the recent Fruit Conference in Jamaica that great caution be exercised before undertaking any further planting of this crop.

It is to be seen therefore that from the outset, good oranges and other seedling citrus fruit had been grown with varying success in suitable localities in the colony. In addition to the reefs and areas of lighter soil on the coast, the Canals Polders on the Demerara River and like alluvial sites had proved satisfactory, but the heavy coastland clays, similar to the soil of the Botanic Gardens, were unsuitable. The soils of the interior have been but little explored in this respect.

But while it had been found that the fruit of the introduced varieties mentioned above had little to commend it in comparison with the best local seedlings as an article of dessert, yet these latter were a nondescript collection, unsuited by size and uniformity of appearance, and to some extent by flavour, to fulfil the standardized requirements of Northern markets. Moreover, until the seedling had borne, before which a longer period elapses than with a budded plant, there was no certainty as to what quality fruit it would yield. If, therefore, the colony was to keep pace with its neighbours in the matter of citrus cultivation, the establishment of good budded trees was essential.

The Recent Introduction of Standard Varieties.

The world-wide demand for Citrus fruits, and in particular Grapefruit, having increased considerably of recent years, agriculturists in all parts of the world

where citrus grows looked to the possibility of extending their cultivation and capturing a part of the many markets available.

In this colony it was realised that certain areas offered opportunities for citrus culture, but that if any export of fruit was contemplated, this fruit must be of the standard varieties known to the trade and to consumers in other countries. Accordingly in 1928, with the re-organisation of the Department, the Director introduced a number of budded plants of different varieties from the Trinidad Department, and also obtained budwood from the same source to bud on to stocks grown at the Botanic Gardens' nurseries. At the same time too, certain introductions were made from a Florida citrus nursery.

A representative of the Department visited Trinidad and studied the methods of propagation in vogue there, and as a result it was found that budding could be carried out at the local Gardens, contrary to previous experience, with a percentage of success which fully warranted its continuance.

The laterite hills at the Hosororo Experiment Station in the North West District offered a suitable site for an orchard of budded plants, (Plate I, Fig. 1) and in 1928 and 1929, as plants came to hand, some 18 acres were planted with citrus at Hosororo, together with an additional four acres at Wauna Sub-station, also in the North West District, where plants were tried on a sandy soil typical of the sand reefs of that district.

Table I. gives a list of the varieties under cultivation at these two Stations. These include a number of trees of the better known varieties of Orange and Grapefruit and a few specimens of less common types. Amongst the latest additions are some varieties of Tangelo—a cross between Tangerine and Grapefruit.

TABLE I.

BUDDED CITRUS TREES AT NORTH-WEST DISTRICT EXPERIMENT STATIONS.

HOSORORO (LATERITE SOIL).

Grapefruit.		*Limes.*	
Marsh (Trinidad)	209	Budded Limes	175
Marsh (Florida)	5	Seedling „	175
Duncan	76	Smooth skinned (St. Lucia)	26
Foster	8	W.I. × Woglum's (Dominica)	2
Walters	8		
Pernambuco	2		
Labuan	2		
	310		378

Photo by *E B Martyn*

FIG. 1 — Part of the citrus orchard at Hosoroio, N W D

Photo by *C. L C. Bourne*

FIG. 2.—Two cases of 'bench root' compared with a normal plant of Sour Orange.

TABLE I. *(Contd.)*

Oranges.		*Tangelos.*	
St. Michael's Blood	6	New	1
Late Summer	5	Sunrise	1
Jaffa	4	Williams	1
T. H. Late	9	Sampson	1
Dancy Tangerine	16		4
Lue Gim Gong	10		
Ruby	11		
Parson Brown	10		
Pine Apple	11		
Homosassa	3		
Navel	14	*Lemons.*	
Valencia	11	Ponderosa	4
Satsuma	3	Sicily	3
Grenada	4	Hybrid, Trinidad	2
	117		9

WAUNA SUB-STATION (SANDY SOIL).

Grapefruit.		*Limes.*	
Marsh (Trinidad) (42 on Rough Lemon stock, remainder on Sour Orange Stock.	84	Budded Limes	42

Oranges.		*Tangelos.*	
Parson Brown	13		
Dancy Tangerine	8	New	2
Valencia	16	Sunrise	2
Navel	22	Williams	2
King Orange	6	Sampson	2
	65		8

(38 on Rough Lemon stock, remainder on Sour Orange Stock.)

The main object of these plantings was to secure information as to the types of both stock and scion most suited to local conditions, to form a source of budwood supply for future propagation, and to obtain data on yields, manurial treatment, etc.

In addition, a nursery was started at. Hosororo, on lines parallel to that in the Botanic Gardens, to produce plants for local farmers and estates. A minor outbreak of Scab occurred here a short while ago, probably introduced with bud-wood from Trinidad, but the disease was stamped out before it had obtained a firm footing.

NURSERY WORK AT THE BOTANIC GARDENS.

It will be understood from what has been said above that the Botanic Gardens are by no means an ideal site for the production of budded citrus plants. The soil is a heavy clay, and good drainage is only obtained with difficulty. The distribution of rainfall and the periodicity of wet and dry seasons vary considerably, and in wet weather the excessive precipitation is a serious handicap. Unless special precautions are taken, stocks in the nursery beds tend to develop but one main tap root, with few secondary roots, which is pushed down into the clay. The result is the loss of many plants by severance of this, the only root, when lifting for basketing; and furthermore, if this root has penetrated to a depth waterlogged during wet weather, the plants begin to wilt. Also the condition known as 'bench root,' (see Plate I, Fig. 2,) usually attributed to the formation of a crooked root at the outset, when the seed coat is hard and the embryo can only penetrate it with difficulty, seems to be accentuated by the effort of the lengthening root to penetrate the stiff soil.

From the outset, to overcome these difficulties the soil of the nursery beds has been mixed with a quantity of burnt earth dust, or else with the red gravelly soil from Hosororo, and the beds themselves have been well built up, with deep drainage between. The greatest improvement was obtained however, by the introduction of a system of bamboo drains underneath each bed, which have resulted in the formation of a considerably better distributed-root system by the seedlings.

The stocks employed have been mostly sour orange, together with some seedling grapefruit and a small amount of Rough Lemon. In the nursery the grapefruit stocks were found to make more rapid growth at the outset, but the sour orange, although slow to grow, ultimately develop a rather more spreading root system. The subsequent relative merits of these two stocks are also being compared by observations made on citrus plantings on the coastland. The Rough Lemon stocks are being tested at Wauna in the North West District for their suitability on sandy soils in comparison with the Sour Orange.

The general procedure in the nurseries is as follows:—The seed is sown in seed troughs (Plate II, Fig. 3), and if wet weather be experienced at this stage, losses may be considerable. After some 7-8 weeks the seedlings are set out in the beds. Grapefruit seedlings can be budded after six months, but sour orange require 7-9 months before they are of an average size to begin budding (Plate II, Fig. 4). After another interval of 7-9 weeks the successful buds have sprouted, the part of the stock above the insertion of the bud has been removed,

Photo by *C. L. C. Bourne*

FIG. 3 :—Sour Orange Seedlings in the seed box, ready for bedding out.

Photo by *C. L. C. Bourne*

FIG. 4 :—Sour Orange Stock ready for budding.

PLATE II

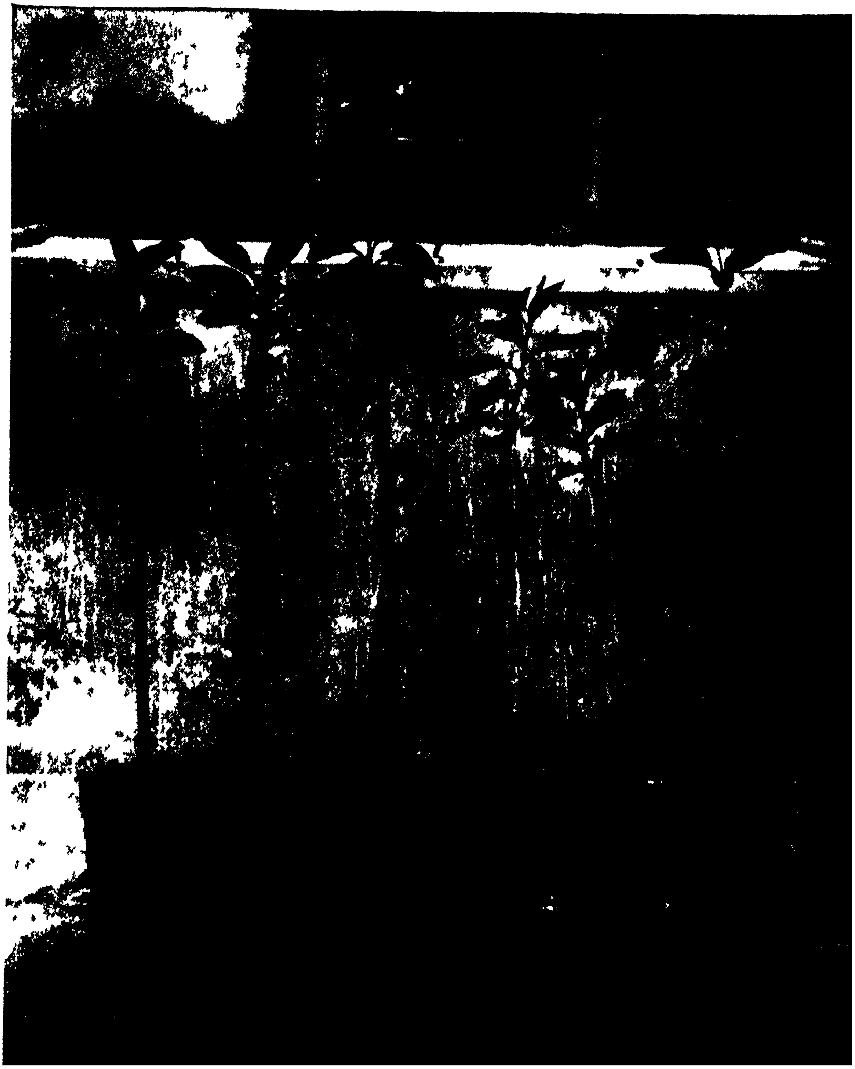

Photo by *C. L. C Bourn*

FIG. 5.—Budded plants basketed.

and the plants are lifted and basketed. They are finally kept for some six weeks in the nursery to eliminate any weak plants, and are then ready for distribution (Plate III, Fig. 5). The whole process thus requires about a year to 15 months.

The basketing of the plants, though entailing additional labour, and differing from the usual nursery practice where plants are sold straight from the beds, is necessary under local conditions, as delays occur in transit, and many farmers do not plant their young trees until some time after they have been received. The baskets it may be added, which are large and spacious, are made from the split stems of *Iscnosiphon* spp., known locally as 'Mukru.' (Plate III, Fig. 5).

When budding, the bud is inserted at a height of 1½ to 2 feet from the 'collar' (Plate III, Fig. 5). On an average rather over 60 per cent. of the seedlings budded ultimately yield good plants, a percentage which may be considered as fair under prevailing conditions, and when it be remembered that the majority of the budwood is imported and that until a few years ago this form of propagation achieved so little success as to be considered impracticable.

Table II indicates the total distribution of budded citrus during the past four years from the Botanic Gardens and the Hosororo nurseries :—

TABLE II.

	1930			1931			1932			1933			Total Distribution 1930—1933
	Gardens	Hosororo	TOTAL	Gardens	Hosororo	TOTAL	Gardens	Hosororo	TOTAL	Gardens	Hosororo	TOTAL	
Budded Oranges	191	175	366	853	37	890	394	...	394	*1872	600	2472	4122
Budded Grapefruit	268	...	268	1383	186	1569	433	380	813	1158	224	1382	4032
Budded Limes	...	100	100	117	1969	2086	...	1195	1195	...	497	497	3878
Seedling Limes	...	...	...	342	9418	9760	...	6221	6221	...	268	268	16249

**455 of these plants were grown at Hosororo and sent to Georgetown for distribution.*

It will be seen that the output of plants from the Gardens' nursery has increased considerably in the last year, although a number of the orange plants distributed were received from the Hosororo nursery. On the other hand, as the tables show, a year of high output is followed by one of less, the reason for this being that the nurseries have now been extended to their utmost, and that a period of over a year elapses after the plants from any one section have been lifted before budded plants will again be ready in that section.

VARIETIES PROPAGATED.

The majority of the Grapefruit distributed from the Botanic Gardens are Marsh; Duncan comes second, and a certain amount of Foster and Walters have also been propagated. At the recent Jamaican Fruit Conference it was recommended that Marsh, which though originally known as 'Marsh Seedless' often contains a number of seeds, should be the principal variety planted in the West Indies, as being in the greatest demand in all markets. Duncan and Foster were recommended as secondary varieties. Duncan, though containing a large number of seeds, is a hardy variety of good quality. Foster, which also contains a large number of seeds, is similar to Walters, but differs in having a pinkish tinge to the flesh.

As regards oranges, a number have been propagated by the Department, including the well-known varieties such as Jaffa, Majorca, Navel, Parson Brown, Ruby, and T. H. Late or Valencia, etc., and several of the Tangerine types. In addition, Lue Gim Gong, which was mentioned at the Jamaica Conference, is under trial at Hosororo.

Besides these, budwood has been selected from some of the best local seedlings at Pln. Haags Bosche on the East Bank, and from the Pomeroon, and plants of these varieties raised. Fruit from such trees will be well suited to local requirements, and could probably find a market in the West Indies, since in favourable years the local citrus season begins rather before that in the islands.

RESULTS OF EXPERIMENTAL WORK.

In the comparatively short time since the Citrus orchard ~~orchids~~ at Hosororo was planted and a citrus nursery has been in existence at the Botanic Gardens, it has not been possible to collect much data. Some of the oldest trees at Hosororo bore their first crop at the end of 1933 however, and certain points have already become noticeable.

Most striking is the amount of variation to be seen in the Grapefruit the budded Marsh trees planted at the end of 1928 (Plate IV, Fig. 6). Some have borne a fair crop, others not at all, some have fruit of good size and shape, others of irregular shape or so large as more to resemble shaddocks. The fruit ripens to a good colour, but is often blemished externally by thrips and other agencies. On cutting open many of the fruits show a very thick skin, possibly due in part to the high rainfall, but on the other hand they contain plenty of juice, and are for the most part of good flavour, having the rather acid tang which is preferred in Northern Markets, and which is quite distinctive from the very sweet flavour of the better local seedlings.

Many of the oranges of standard varieties at Hosororo have yielded good fruit, but the tendency in some cases is for the fruit to be on the small side, the Dancy Tangerines especially being very small and of poor flavour. The colouring too, is poor and uneven. The larger oranges however, are sweet and of good juice content. Considerable variation in shape and size of fruit also occurs

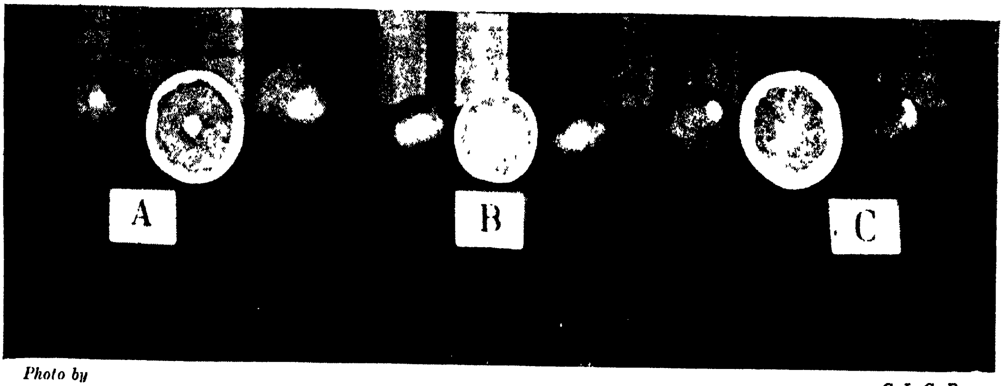

Photo by *C. L. C. Bourne*

FIG. 6:—Varying types of Grapefruit from three different 'Marsh' trees at Hosororo.

Photo by *C. L. C. Bourne*

FIG. 7:—Varying types of orange fruit from the same tree, (Var. Luo Gim Gong)

amongst the oranges of similar variety, occasionally being very marked even amongst fruits on the same tree (Plate IV, Fig. 7).

An application of artificial fertilizer was made to some of the trees for the first time in 1933, Sulphate of Ammonia, Phosphate and Potash being applied in the proportions 2: 4: 1: The results of this application remain to be seen.

It is too early as yet to judge the relative merits of the various stocks which have been tried, but it may be noted that in an area on the East Bank, Berbice River, planted three years ago on somewhat heavy clay, Grapefruit on seedling Grapefruit stock has made a very rapid start in comparison with orange on Sour Orange stock in the same plantation. It is also well in advance of Grapefruit of the same age on Sour Orange stock in another locality in Berbice, where the site is on a sand reef.

GENERAL.

Citrus cultivation in this colony is a venture to be undertaken with the greatest caution. Everyone should have one or two good fruit trees planted near their house for their own use, but when planting on a bigger scale, questions of capital and markets must be taken into consideration.

Citrus cultivation on a commercial scale has received a good deal of attention in Trinidad of recent years, and a series of experiments have been laid down there dealing with the selection and preparation of suitable planting material and the best methods of soil treatment. Discussing the question of the conversion of former Cacao lands into Grapefruit plantations, Mr. Williams, Economic Botanist of the Trinidad Department of Agriculture, dealt in a recent paper with the prinicipal factors involved. As regards costs, he showed that in that colony the money required to plant and cultivate an acre of Grapefruit for the first five years might be taken as between $400 and $500, after which time there should begin to be a turnover. Furthermore, he pointed out, the cultivation of Grapefruit called for a high cultural standard, but being a new crop, labour and supervision at the outset were unskilled.

Citrus therefore cannot be looked upon as a small farmer's money crop ; it calls for capital, and patient waiting, and its cultivation is set with numerous difficulties. This however should not deter local farmers from growing citrus for their own consumption and to meet local demands. Some of the lighter and better drained lands and suitably located dams can be used to good advantage for this purpose, and the more suitable areas offer opportunities to the planter with some capital who is prepared to undertake operations on a larger scale.

Those who contemplate citrus cultivation on a large scale are strongly advised to lay out their own nurseries. The output of plants from the Department's nurseries is necessarily limited, and those who place large orders have often to wait some time for their fulfilment, or to take plants at a time not ideally suited to them. On the other hand, the Department of Agriculture will give every assistance in directing operations, in showing how to bud the seedlings, and in securing budwood. The advantages to the planter are manifold, as firstly he

will be able to choose the most suitable ground for his nursery, and secondly he can raise a number of plants in excess of his requirements, pick only the best from these for planting, and still have a number of good plants to supply any failures. Plants may be lifted and planted direct from the nursery, which eliminates the need for basketing, and can be ready just when it is suitable to put them out, Lastly, the planter is able to take a personal interest in his trees from the beginning, and a good budded citrus tree is to be regarded as a capital investment, to be given every care and consideration from the outset to ensure reaping the due profit when it matures.

As regards selection of a suitable site, the primary question for prospective plantings on the coastland is the matter not only of soil but of drainage. The area chosen must be well drained at all times, and there must be no liability of the ground becoming waterlogged or flooded during unusually wet seasons. Furthermore, on the coast protection must be assured from the trade winds. Accessibility too, is an important question with regards to marketing costs.

Finally there is the question of markets. In the first place there is a local market, which by judicious use of cold storage, enabling fruit to be held till the height of the season is over, could be considerably extended. Good seedling fruit, and more especially fruit from trees budded from selected local seedlings, are most suited to this. In addition there may be an opportunity to ship fruit of this nature to some of the neighbouring West Indian Islands, and Bermuda, since seasonal variations as regards time of fruiting appear to offer possibilities in this direction. This question is being further investigated, with relation to time of flowering and the effects of the fluctuations of the local wet and dry seasons upon the subsequent bearing of citrus in the colony.

As regards an export trade to Northern markets, while quality and appearance count for everything when fruit is shipped whole, there are likely to be openings for canned fruit and for fruit juices. To produce locally a fruit that will compete in appearance with citrus grown under more suitable conditions in other countries is not easy. Some of the very varied fruits that have been grown at Hosororo might be suitable for export, others certainly are not. These trees however, have only just come into bearing, and an improvement in the quality of the fruit may be expected as they mature. It will be necessary to select budwood from the best trees, and gradually plant up a number of areas with these selected strains, fruit from which after grading and washing would have the appearance demanded by Northern markets. On the other hand, fruit which though of poor appearance is juicy and of good flavour, would be well suited to canning or for juice extraction.

In conclusion, an attempt has been made in this article to give some idea of the work being carried out by the Department of Agriculture with regard to citrus cultivation in the Colony. The difficulties which attend its establishment as a minor industry have been indicated, and the lines along which development may be expected have been outlined.

ILLUSTRATIONS.

SUGAR FACTORY RESULTS IN BRITISH GUIANA, 1932.

BY

R. R. FOLLETT-SMITH, B.Sc., A.R.C.S.

Chemist.

In recent years the majority of the sugar estates of British Guiana have reported their factory results for the compilation of an annual comparative statement. While the figures for the individual factories are not available for publication, yet it is of interest to consider the arithmetic means of the fifteen reporting factories for the year 1932 and to compare them with the published results of other countries during recent years.

It is realised that weighted averages would have given a more accurate picture of the factory work in this colony and, since most of the cane is handled in the more efficient factories, such weighted means would have shown improved results. It is not possible with the information available to calculate these averages.

The figures appear in the following table and are there compared with the results obtained in Natal[1], Java[2], Mauritius[3], and Queensland[4].

TABLE I.

The most striking points brought out by an examination of this table are (1) the poor sucrose quality of the canes of the colony and (2) the comparatively low purity of British Guiana cane juice. The probable causes of this position are discussed in a later paragraph.

The fibre content of the cane is similar to that of other countries and is naturally lower than that obtained in Natal where Uba cane forms the greater part of the crop.

The sucrose content of the bagasse might be slightly decreased by the use of more maceration water and by heavier crushing and such alterations would naturally increase the extraction of sucrose from the cane. The sucrose extraction figure however, compares favourably with the results obtained in other countries, and it is probable, with the quality of cane ground in this colony, that any attempt to improve the sucrose extraction would be accompanied by a reduction in the boiling house recovery, due to the presence of increased amounts of non-sugars in the juice, finally resulting in a decrease in overall recovery.

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[1] Proc. 7th. Congress of S.A. Sugar Technologists Association.
[2] International Sugar Journal.
[3] Control Tables, Mauritius.
[4] 33rd Annual Report, Bureau of Sugar Experiment Stations, Queensland.

The purity of the final molasses obtained in this colony indicates that the work in the back of the house, *i.e.* boiling, crystallising and curing, is generally efficient. Due to low purities more molasses are obtained in British Guiana factories.

The average polarisation of sugar is lower in this colony than in the other four countries where direct consumption sugar is manufactured by more refined processes.

The overall recovery (sucrose in sugar % sucrose in cane) is, with the exception of Natal, lower than that obtained in other countries. This is almost entirely due to the quality of cane obtained in British Guiana. It does not appear wise to strive for greater milling efficiency and the relatively impure juice naturally affects the recovery in the boiling house.

Despite these conditions the work in the boiling house (sucrose in sugar % sucrose in juice) compares favourably with that of other countries whose intensive methods of clarification should eliminate more impurities and should make for greater efficiency.

With the poorer quality of cane and juice encountered in British Guiana it is only to be expected that more tons of cane would be required to manufacture one ton of sugar in this colony than in the other countries. This point is confirmed by the actual yield figures* which would be even more striking if all the sugars were calculated to the same polarisation.

In general, the position may be summarised by saying that, having regard to the inferior quality of the cane and juice obtained in this colony, the average factory results both in the mill house and in the boiling house indicate efficiency in manufacture.

Under present conditions, therefore, it does not seem likely that any marked economic improvement is likely to take place in the factory work, and attention might be devoted to alterations in field practice with greater hope of success.

It is generally assumed that the growth of cane depends upon the presence in the soil of adequate amounts of water and of plant nutrients and upon a sufficiently high temperature. The ripening of cane depends more upon dry and cool weather. In British Guiana the air temperature is very uniform throughout the year. It follows, therefore, that while, in other sugar-cane growing countries ripening is assisted by dry weather and cool temperatures working together, in this colony ripening conditions are never ideal and depend almost entirely upon the incidence of rainfall which governs the soil moisture content.

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*The weighted mean of the fifteen British Guiana factories is 10.82 tons of cane per ton of sugar as compared with the arithmetic mean of 11.11 tons reported.

It is generally believed that the river lands of the colony experience colder nights and this may account for the superior juice purities obtained on the river estates. At the same time it must be remembered that the soils of these estates are likely to be naturally better drained and to be less saline than those of the coast estates.

The most important factor governing the growth of cane in this colony is the provision of adequate drainage. Without good drainage the production of new varieties and the application of manures are of little value. Thorough drainage of the colony's flat, impermeable, clay soils is a difficult matter to accomplish, but the production of a sweeter cane and higher juice purities depend to a large extent upon the provision of adequate drainage.

The soils of many estates, particularly those on the coastlands, contain considerable quantities of soluble salts which, no doubt, adversely affect the juice purity. The elimination of these harmful salts may gradually be accomplished by flood-fallowing, thorough drainage and deep tillage.

The practice of burning cane prior to reaping probably has an unfavourable effect upon juice purity especially when associated with the delays caused by discontinuous grinding. In this connection the storage during the night of considerable quantities of hot juice and syrup must have an unfavourable effect upon factory recovery. There appear to be, however, many obstacles in the way of continuous grinding.

Another important cause of poor juice purity is the reclining habit of D. 625, the most widely planted seedling in this colony. The policy, adopted at Sophia Experiment Station since 1929, of crossing local canes with foreign canes of considerable reputation will, it is hoped, lead to the production of a heavy cane of erect habit possessing desirable juice characteristics.

A consideration of these facts leads to the conclusion that any marked improvement in the premier industry of this colony in the near future is likely to be the result of alterations and improvements in field operations.

	British Guiana 1932	Natal 1932	Java 1932	Mauritius 1931	Queensland 1932
CANE.					
Per cent. Sucrose	11.05	13.48	13.22	12.73	15.90
Per cent. Fibre	12.48	15.65	12.60	13.70	11.51
BAGASSE.					
Per cent. Sucrose	3.44	3.83	2.84	2.97	3.26
Per cent. Moisture	47.13	51.89	44.90	45.20	52.16
MILLING.					
Sucrose extraction	91.84	89.86	94.60	93.70	94.58
JUICE.					
Crusher juice purity	81.44	87.89	84.30	86.40	89.64
Mixed juice purity	79.43	85.30	...	83.20	...
Clarified juice purity	80.07	86.79	...	...	89.15
SYRUP.					
Purity	80.05	86.84	...	83.90	89.42
FINAL MOLASSES.					
Purity	32.68	45.06[2]	30.50	39.40[2]	38.31
Per cent. Cane	3.98	3.29	...	3.18	2.71[3]
SUGAR.					
Polarisation	96.13	98.14	...	98.50	98.35
RECOVERY.					
Sucrose in sugar % sucrose in cane	78.56	75.73	85.83	81.30	86.88
Sucrose in sugar % sucrose in juice	85.49	84.27	90.63	86.70	91.86
SUCROSE BALANCE. (% Sucrose in cane)					
Sucrose in bagasse	8.21	10.14	5.34	...	...
Sucrose in filterpress cake ...	0.70	} 14.13	0.62	...	...
Sucrose in molasses	} 12.53		6.53	...	...
Sucrose undetermined ...			1.68	...	...
Sucrose in sugar	78.56	75.73	85.83	81.30	86.88
YIELD.					
Tons Cane per ton of Sugar ...	11.11	9.61	...	9.51	6.885[1]

[1] 94 n.t. sugar.
[2] Clerget purity.
[3] Assumed 85° Brix.

PADI VARIETY TRIALS CONDUCTED DURING 1933.

BY

L. E. W. CODD, M.Sc., *Plant Breeder*,

AND

A. DEK. FRAMPTON, C.D.A., *Agricultural Superintendent, Essequibo*.

During 1933, six selected padi varieties were put down in trials at the Experiment Station, Georgetown, at La Jalousie, West Coast, Demerara[1], and at Henrietta, Essequibo.

The varieties tested were :—

Variety	Growth Period (months)	Origin
Demerara Creole	5	Local selection
No. 79	5	Local selection
Blue Stick	5	Local selection
H 7	5	Local selection
Ramcajara	$4\frac{3}{4}$	Local selection
Kalyaman	5	Trinidad

In each trial, the plots were $\frac{1}{80}$th acre in area and were surrounded by strips to eliminate border effect.

Rainfall was somewhat above the average throughout the season. The Essequibo trial was sown later than the others and suffered considerably from abnormal rains in November and December.

(1) This trial was put down by Mr. J. D. Gillespie, Agricultural Superintendent, West Demerara, before proceeding on leave.

The mean yields obtained, expressed in Lbs. padi per acre, are shown below :—

SITUATION :	GEORGETOWN		LA JALOUSIE		HENRIETTA	
LAYOUT :	Three 6 x 6 Latin Squares		Two 6 x 6 Latin Squares		Two 6 x 6 Latin Squares	
VARIETY	Padi, Lbs. per acre	Order of Merit	Padi, Lbs. per acre	Order of Merit	Padi, Lbs. per acre	Order of Merit
No. 79	3186	1	4048	1	3320	1
Blue Stick	3162	2	3704	2	2786	2
H 7	2935	3	3392	6	2626	5
Demerara Creole ...	2786	4	3456	5	2638	4
Kalyaman	2769	5	3696	4	2652	3
Ramcajara	2578	6	3704	2	2478	6
Significant Difference	126		197		300	

It will be seen that the variety *No. 79* has secured first place in each trial and, except in the Georgetown trial, was significantly better than all other varieties. This variety is recommended to farmers not on its yield alone, but also on account of its ability to withstand adverse conditions.

Blue Stick usually does well in Essequibo, and gives an indifferent yield in Demerara. Its success in this trial may be attributed to the absence of a leaf disease which has been observed to attack it in previous years [1].

H7 and *Demerara Creole* were slightly more successful in East Demerara than in West Demerara and Essequibo.

Kalyaman is a long-grained variety which appears to be equal to *Demerara Creole* in yield.

Ramcajara was significantly lower than all other varieties in the Georgetown trial, and also gave the lowest yield at Henrietta. Its chief advantage is that it matures slightly earlier than the other standard varieties.

Varietal susceptibility to "man rice" disease.

The damage caused by this disease is very slight, though affected plants exhibit a very striking appearance in the field. The diseased tillers become elongated, turn pale green in colour, and stand out clearly against the healthy

(1) Peterkin, E. M. and Follet-Smith, R. R.: Agricultural Journal of British Guiana, 1931; VI; 195-197.

plants. They usually wither and are replaced by fresh shoots. Farmers sometimes express the opinion that the disease is more prevalent in the Departmental pedigree selections than in the mixed padi which is often grown in the districts.

The possibility of varietal susceptibility to this "man rice" disease was investigated during the early stages of the Georgetown trial by counting the number of diseased plants in each plot. There were approximately 1200 clumps in each $\frac{1}{80}$th acre plot, and the general mean for all varieties was 5.3 affected shoots per plot. There were, however, distinct varietal differences, as will be seen from the figures set out below :—

Variety	Mean No. "man rice" plants per plot.
No. 79	0.6
Demerara Creole	3.5
Blue Stick	5.2
H 7	6.2
Kalyaman	7.0
Ramcajara	9.2
Significant Difference (P=0.05)	2.2

No. 79 is significantly more immune than all other varieties. *Ramcajara* was found to be the most susceptible with a mean of 9.2 "man rice" plants per plot. Even this represents an incidence of less than 1%, so that the loss caused by this disease may be taken as negligible.

SELECTED ARTICLES.

THE WORLD RICE SITUATION

BY

C. J. ROBERTSON.

World rice production in the past decade has shown two very marked upward movements—in 1924-25 and 1930-31—with a less notable rise in 1928-29. In 1931-32, however, there was a pronounced fall in production. The data now available, which covers countries accounting in 1931-32 for about 93 per cent. of the world total excluding China, for which no reliable statistics exist, point to a continuance of the decline in 1932-33, though to a moderate degree, the percentage fall in the past season amounting to about 1 per cent.

WORLD PRODUCTION OF ROUGH RICE (1)

(Million pounds)

Year	
1931-32	194,735
1930-31	201,680
1929-30	188,760
1928-29	192,420
1927-28	184,241
1926-27	185,013
1925-26	185,299
1924-25	186,864
1923-24	172,733

In the past season there were considerable increases of production in Burma and in Siam, while that of French Indo-China appears to have remained practically at the same level, the decrease in Cochin-China being balanced by the increase in Annam; in Korea, Formosa, Japan and the Netherlands East Indies

* Reprinted from International Review of Agriculture, June, 1933.

(1) Not including that of China, Turkey and Persia.

there were also increases. On the other hand there was a very great fall in production in India excluding Burma, the effect of this on the total being an indication of the critical part played by the area in determining the variation of world production as a whole. The variation of production in the principal producing countries, with the possible exception of French Indo-China, where the total has in the last few years remained relatively stable, and of Formosa, where there has been a continued increase, has been the reverse of that of the previous season.

Even without taking into account the very large but statistically unknown production of China, 94 per cent. of the world's total in the quinquennium ending 1931-1932 was produced by the countries of monsoon Asia. Similarly, all but a relatively small proportion of the rice entering into international trade also originates in monsoon Asia, the principal surplus producing countries being Burma (principally Lower Burma), French Indo-China (principally Cochin-China), Siam (almost entirely the five inner circles), Korea and Formosa. Since the two last named countries supply principally Japan and form with that country practically an economic unit, the supply situation on the world market depends principally on the crops of Burma, French Indo-China and Siam.

THE SITUATION IN THE THREE GREAT SURPLUS PRODUCING COUNTRIES.

Despite the continuance of low prices there was in the past season a recovery in the area under padi in Burma, though the maximum of 1930-31 was not regained. Production, which in the past decade has, with the exception of 1931-32, when a reduction in area coincided with a weak monsoon, fluctuated only slightly about the level of 12,000 million pounds, increased by 17 per cent. in the past season.

The increase in area in the past season took place particularly in Lower Burma, from which the bulk of the export is derived. Production in 1932-33 increased, thanks to the increase in area and to favourable weather, and the final estimate of the surplus available for export (that is the exports in the year beginning in the middle of last December) showed an increase of 28 per cent. on the very small figure of the previous season. As total exports in 1932 amounted to 6,326 million pounds while the final estimate of the export surplus from the 1931-32 crop was only 6,048 million pounds, there was presumably no carry-over at the beginning of the present export season and domestic stocks were probably greatly reduced in 1932, so that the surplus estimated for the current year may be taken as a maximum ; in any case, actual exports during the past ten years have been more often than not smaller than the surpluses as finally estimated.

Exports (mainly of milled rice) from Rangoon to foreign ports, and to Indian ports which together normally make up about three-quarters of the total exports of Burma, in the period from 1st January 1933, a date only fifteen days after

the beginning of the season, to 27th May, 1933 were respectively 1,535 million and 787 million pounds (against 1,970 million and 393 million in 1932), in all 2,322 million against 2,363 million pounds.

Production and Net Export of Major Exporting Countries.

(Million pounds rice and rice derivatives)

Year	Production			Year	Net Export			
	Burma	French Indo-China	Siam		Burma [1] to foreign countries	to Indian Ports	French Indo-China	Siam [2]
1932—33	12,142	[3] 8,364	[4] 8,120	1933	...	...	...	...
1931—32	10,351	9,034	6,781	1932	4,219	2,107	2,624	3,379
1930—31	12,724	9,624	8,044	1931	4,323	3,177	2,101	2,683
1929—30	12,335	9,557	6,458	1930	5,187	2,015	2,465	2,315
1928—29	12,108	9,250	6,470	1929	3,930	2,269	3,229	2,625
1927—28	12,088	10,333	7,607	1928	3,379	2,856	3,904	3,500
1926—27	12,647	9,561	8,710	1927	4,383	2,414	3,630	3,708
1925—26	11,734	9,440	6,989	1926	4,621	1,457	3,506	2,780
1924—25	12,536	9,241	8,236	1925	4,805	2,754	3,277	2,947
1923—24	10,309	8,334	7,332	1924	4,138	1,042	2,646	2,278

Production in French Indo-China has fluctuated in the last decade between 9,000 and 10,000 million pounds. The export originates mainly in Cochin-China, which produces about one-third of the total. Rather less favourable conditions during the period of transplanting outweighed the increase in area in this region. The export surplus from the past crop is considered to be smaller than that from the 1931-32 crop ; the most recent estimate places the surplus for export from Saigon during the present year at 2,464 million pounds, 291 million smaller than in 1932. Actual exports in the first three months of 1933 showed an increase of 13 per cent. on those in the corresponding period of 1932.

(1) The official data are for rice both in the husk and not in the husk, but, as practically all the rice exported is milled, they have been taken to represent milled rice and derivatives.

(2) Exports from Bangkok, which make up 98 per cent. of the value of the total rice exports from Siam. Data refer to the season from 1st December to 30th November.

(3) Not including Cambodia.

(4) Provisional estimate.

Production in French Indo-China.
(Million pounds rice and derivatives)

Year	Cochin-China	Cambodia	Tonkin	Annam	Laos
1932—33 ...	3,267	...	2,892	1,642	563
1931—32 ...	3,636	781	2,903	1,183	531
1930—31 ...	2,985	1,446	3,220	1,442	531
1929—30 ...	3,484	1,047	2,990	1,505	531
1928—29 ...	3,405	976	2,849	1,473	547
1927—28 ...	3,876	1,273	3,013	1,543	628
1926—27 ...	3,405	1,448	2,211	1,918	579
1925—26 ...	3,240	1,179	2,923	1,535	563
1924—25 ...	3,565	902	2,521	1,770	483
1923—24 ...	3,314	927	1,801	1,646	644

In Siam, as in Burma, and to a much less extent, in French Indo-China, there was an increase in the area of rice harvested in the past season, amounting in this case to 8.5 per cent. Production increased more than proportionately, namely by 20 per cent. The final estimate of the exportable surplus is 3,942 million pounds, which is over double the small export surplus of the previous season. Actual exports from Bangkok in the first four months of the export season were larger than those in the corresponding period of the last season.

The Situation in The Minor Exporting Countries.

While their total production is relatively insignificant as compared with that of the great Asiatic producers, certain of the minor producing countries have special importance on the European and other markets where a demand for high quality rices exists.

Amongst these producers of high-quality rices the most important are the United States, Italy and Spain.

There was a pronounced fall in production in the United States in 1932-33 and a slight fall in Italy, but in Spain production rose almost to the 1926 maximum. In the last-named country the increase in production, amounting to 19.5 per cent. with respect to 1931, was due in part to increase in area, which amounted to 8.6 per cent., but still more to favourable growing conditions. In the United States there was a general reduction in area and in the three Southern States (Louisiana, Texas and Arkansas) unfavourable weather also played a part in reducing production to a figure 14.5 per cent. below that of 1931 and 9.0 per cent. below the average for 1926-30. In Italy a reduction in area under the crop was outweighed by conditions on the whole favourable to growth.

Amongst other minor producers of relative importance Egypt had in the past season a production much above the five-year average, thanks to the abundance of irrigation water, which enabled the Government to authorize an area under the crop over seven times the greatly reduced area of the previous year.

PRODUCTION AND NET EXPORT OF MINOR PRODUCING COUNTRIES.
(Million pounds rice and derivatives).

Year	Production			Year	Net Export		
	Italy	Spain	U.S.A.[1]		Italy	Spain	U.S.A.[1]
1932	1,057	491	1,240	1933	...	...	...
1931	1,066	411	1,449	1932	335	87	270
1930	1,084	482	1,415	1931	327	83	237
1929	1,016	452	1,279	1930	456	125	252
1928	1,120	448	1,368	1929	379	86	376
1927	1,094	478	1,410	1928	413	131	286
1926	1,013	494	1,338	1927	561	118	251
1925	951	472	1,047	1926	430	142 [2]	60
1924	838	456	1,015	1925	333	99	68
1923	747	374	1,062	1924	387	116	165

Exports from Italy, which in 1932 showed a decline of 3 per cent. for milled rice and of 11 per cent. for brown rice, declined further in the first quarter of 1933 with respect to the same period of last year by 56 per cent. and 35 per cent. respectively. Exports of rough rice, on the other hand, increased about 8½ times in 1932 and over three times in the first quarter of 1933. In Argentina which is the most important foreign market for Italian rice, there is reported to have been a great increase in the area harvested. Exports of milled rice from Spain increased by 4 per cent. in 1932, the decrease in takings of the United Kingdom and Cuba, the two leading markets, have been outweighed by the increase in those of France and certain other countries. Exports of milled rice from the United States, which go principally to the United Kingdom and Germany, declined by 27 per cent. in the first quarter of 1933 with respect to the corresponding period of 1932.

The relatively large export from Egypt in 1932 in comparison with previous years, which may be expected to be repeated this year, irrigation water in that country being again abundant, will accentuate competition in the Levant and the Balkan countries.

Exports from Brazil, the principal South American country with a surplus, which are directed chiefly to Argentina, Uruguay and Germany, were in 1932 less than one-third of the record figure of 1931 ; in the first three months of

(1) August-July. (2) Net import.

1933 they were 88 per cent. below the figure for the corresponding period last year. British Guiana, which has a growing export surplus, is finding difficulty in its principal market, the British West Indies, owing to the competition of Burma rice.

CONDITIONS IN THE PRINCIPAL RICE-IMPORTING COUNTRIES.

Production in India (excluding Burma), which is the world's greatest producer of rice with the possible exception of China, for which no reliable data are available, fluctuates very markedly depending on the character of the monsoon. In 1931-32, production attained the maximum of 71,262 million pounds rice and its derivatives, area having been increased by 2.6 per cent. and rainfall having in that year been unusually favourable over the greater part of the area. In 1932-33, however, there was a reduction of 33 per cent. in area and rainfall was not so uniformly satisfactory. In Bihar and Orissa, which is normally second to Bengal amongst the provinces of India as a producer, the decline in production was no less than 26.8 per cent. below the level reached in the previous season. The deficit regions of India as a whole derive the bulk of their supplies from Burma. The relative shortage in India this year is reflected in the fact that coastwise imports from Burma up to 27th May amounted to 787 million pounds against 393 million up to the corresponding date in 1932.

As regards China, information is as usual somewhat vague; it is reported that the 1932-33 crop was above average and probably about the same high level as that of 1930. In this case it may be expected that imports in 1933 will fall from last year's high figure to the low level of 1931. In fact, imports in the last quarter of 1933 were 25 per cent. smaller than those in the corresponding period of 1932.

PRODUCTION IN CERTAIN PROVINCES OF INDIA.

(Million pounds rice and derivatives).

Year	All-India excluding Burma (1)	Bengal	Bihar and Orissa	Madras
1932—33	63,699	23,063	10,393	12,957
1931—32	71,262	23,483	14,198	13,322
1930—31	66.935	22,775	13,890	13,300
1929—30	64,686	20,292	14,872	13,001
1928—29	67,420	23.958	13,825	12,857
1927—28	57,764	16,064	10,832	12,576
1926—27	60,782	18,196	11,846	11,732
1925—26	64,311	20,331	12,095	13,167
1924—25	64,337	19,078	14,902	12,143
1923—24	59,453	18,587	12,118	11,210

(1) The All-India statistics exclude the production of the Punjab, the North West Frontier Province, Ajmer-Marwara, Manpur, Pargana and certain other Indian States, which together produced 2,602 million pounds on the average of the five years ending 1930-31; they also exclude the production of the feudatory states of Bihar and Orissa, for which no reliable data are available.

Amongst the importing countries of the second rank, the Netherlands East Indies have in the past five years taken the first place. Imports into Java and Madura fluctuate considerably from year to year, depending on the size of the domestic crop; production in 1932-33 was larger than that of the previous year and than the average of the five years ending 1930-31. For the Outer Provinces data of production are not available but it is known that, owing to the concentration of the natives on export crops and to the rapid increase of population, comparatively few areas have normally a surplus. Imports into these provinces are larger and more uniform than those into Java and Madura. In the first quarter of this year imports into Java and Madura showed a decrease of 19 per cent. with respect of those in the same period of 1932; those into the Outer Provinces during the same period were practically the same as last year, there being an increase of 0.4 per cent. Imports into the Netherlands East Indies have been prohibited for the period from 21st March 1933 to 21st July 1933. This embargo will affect particularly Burma, the chief source of imports, but is also a serious blow to the export trade from Siam and Cochin-China. Rice may, however, be imported into the Sumatra East Coast and Celebes by licence, should these provinces require such imports.

In British Malaya acute distress in the rubber and tin industries still dominates the situation in the peninsular. This has not only greatly reduced the purchasing power in the country, both by a general lowering of the standard of living and by leading to the return to India of much immigrant labour, but has also lead to an increase in the area under rice; not only is there the stimulus to many who formerly earned a living from employment in the major exporting industries to engage in rice cultivation but serious efforts are being made by the Government to encourage rice growing with a view to lessening dependence on export crops and assuring a domestic supply of foodstuffs. Yields in the past season were very satisfactory in several States and the crop was generally well above the average. Imports, which have shown a downward tendency in the past two years, were 11 per cent. smaller in the first quarter of this year than in the corresponding period of 1932. The decline in imports of Burma rice, which is preferred by the immigrant Indian population, was apportionately greater. The falling off in this market affects principally, however, Siam rices, which take the first place in imports, largely owing to the taste of the Chinese population.

NET IMPORTS INTO THE PRINCIPAL ASIATIC COUNTRIES OF DEFICIT OTHER THAN INDIA PROPER AND JAPAN.

(Million pounds rice and derivatives.)

Year	China	Netherlands East Indies	British Malaya	Ceylon
1932	2,992	(1) 899	921	1,024
1931	1,427	1,303	1,156	1,006
1930	2,647	1,357	1,329	1,064
1929	1,439	1,592	1,256	1,102
1928	1,683	1,257	1,177	1,093
1927	2,799	1,003	1,228	1,053
1926	2,489	1,292	1,068	1,033
1925	1,679	1,109	907	972
1924	1,759	906	880	884

In Ceylon, as in British Malaya, reduced employment on the plantations with consequent lower purchasing-power and stimulus to local rice production, has resulted in the last two or three years in a decline in rice imports. In the first four months of 1933, the decline in the total with respect to the corresponding period of last year was 14 per cent. This reduction has been felt less severely by Burma, the principal source of imports, than by Siam and Cochin-China, the quantities originating in the latter two countries being, however, small in comparison with those from India proper.

SOURCES OF SUPPLY OF JAPAN.

(Million pounds rice and derivatives.)

Year	Production			Year	Net Import of Japan		
	Japan	Korea	Formosa (first crop)		From foreign Countries	From Korea	From Formosa
1932—33	19,020	5,079	1,322	1933	...	...	...
1931—32	17,346	4,999	1,143	1932	253	1,960	...
1930—31	21,063	6,041	1,094	1931	(2) 91	2,385	723
1929—30	18,758	4,305	896	1930	287	1,318	497
1928—29	18,945	4,245	1,004	1929	384	1,439	521
1927—28	19,510	5,435	1,022	1928	474	1,816	567
1926—27	17,465	4,807	892	1927	1,278	1,440	642
1925—26	18,804	4,641	997	1926	748	1,459	578
1924—25	17,961	4,163	939	1925	1,671	984	567
1923—24	17,463	4,779	819	1924	1,073	1,132	...

(1) Not taking into account the relatively small export from the Outer Provinces.
(2) Net export.

Japan rivals India proper in the quantity of its imports but, as it derives less than one-fifth of its total imports from foreign countries—the remainder being taken from its dependencies, Korea and Formosa—its importance on the world market is very small compared with that of India, China, British Malaya, Ceylon and the Netherlands East Indies.

Imports into Japan fluctuate within wide limits and generally inversely to domestic production. In recent years as production in Korea and Formosa has increased, imports from foreign countries have been reduced. Production in the past season was 9.4 per cent. above that of last year and slightly below the five-year average. Korea, which is the principal source of rice imports slightly increased its production despite a decrease in area, while in Formosa the first crop which is that exported to Japan, was a very large one, thanks partly to increased area but mainly to favourable weather and to the energetic measures taken by the Government on behalf of rice growing. Total production in Japan and its dependencies was almost halfway between the very small figure of the previous season and the record high figure of 1930—31. Stocks are reported to be larger than last year. Government control over the rice trade has been strengthened. Taking all these considerations together it may be expected that imports from foreign countries will this year show a further decline. In fact, while gross exports were 2 per cent. larger in the first three months of the year than those in the corresponding period of 1932, net imports were 20 per cent. smaller. Thanks to treaty obligations Siam and the United States are the only foreign countries to retain any considerable share in the import into Japan ; the imports from the former are by far the greater of the two and are mainly composed of brokens.

THE PRINCIPAL EUROPEAN IMPORTING COUNTRIES.

European imports make up roughly one-fifth of the total international trade in rice. By far the greater part of this rice is worked up in the European mills and much of it is re-exported, generally after milling.

Germany, the largest European importer, takes milled rice and unmilled rice in relative proportions varying from year to year, both principally from Burma. In 1932, the imports of unmilled rice, in that year the larger of the two, showed a decline of 4 per cent. while those of milled rice declined by 9 per cent; exports of milled rice, which are very widely distributed, declined by 24 per cent., a still greater decline than that of the previous year. In the first four months of 1933 there was a decrease of 6 per cent. in imports of unmilled rice and an increase of 11 per cent. in those of milled rice with respect to the corresponding period of last year.

The new import duties and monopoly surcharges that came into force last December together constitute a serious blow to the rice import trade. The reduction in the rate of drawback on the customs duty on husked rice imported into Poland for working up may also be mentioned in this connection.

France imports mainly milled rice. In 1932 its imports of whole milled rice, flour and semolina, chiefly from French Indo-China, increased by 33 per cent. and those of brokens by 13 per cent. while those of rough rice, mainly from Italy, decreased by 10 per cent. In the first quarter of 1933 the total imports increased by 24 per cent.; a large increase in those from the colonies outweighing a decrease of 30 per cent. in imports from foreign countries.

The Netherlands import of rough rice, which is mainly from Burma and Japan, decreased in 1932 by 51 per cent., while that of milled rice decreased by 47 per cent. Exports, which are very widely distributed, decreased by 10 per cent. in the case of rough rice, which goes mainly to Germany, and by 22 per cent. in that of milled rice, which is sent chiefly to Germany and the United Kingdom. In the first four months of 1933 imports of rough rice increased by 72 per cent. while those of milled including brokens, increased by 5 per cent.

Imports into the United Kingdom are almost entirely of milled rice, chiefly from Burma, Spain and the United States. That from Burma, is generally re-milled, however; there is a large import of brokens from this source. In 1932 there was a further increase of 2 per cent. in the total imports, those from British India (mainly Burma) increased by 13 per cent. but those from Spain and the United States decreased by 9 per cent. and 12 per cent., respectively. In the first five months of 1933 there was a decrease of 12 per cent. in the total imports of 64 per cent. in those from the United states, and of 96 per cent. in those from Spain, while those from British India increased by 32 per cent. The great falling off in foreign imports in the current year is due to the coming into force, on January 1, 1933, of a duty of 1d. per lb. on foreign whole milled and cargo rice. Only the superior quality of certain foreign rices enables them to retain part of the market.

THE GENERAL OUTLOOK.

World production appears to have undergone a further decrease in 1932-33. The variation with respect to the previous year in the individual regions of production has, however, been in general the reverse of that in 1931-32. Production in 1932-33 in the three major exporting countries, Burma, French Indo-China and Siam, taken together increased due mainly to the fact that weather during the season was on the whole more favourable in these countries than in 1931-32, when climatic conditions were bad.

In Japan and its dependencies production also increased, mainly as a consequence in Japan and Korea, too, of a reversal of climatic conditions with respect to those of 1931-32; in China also the bad climatic conditions of 1931-32 appear to have been succeeded in the past season by unusually favourable conditions. In India proper, on the other hand, the rainfall conditions were unsatisfactory in several important areas so that the heavy crop of 1931-32 was followed by a deficitary crop in 1932-33. In Java and probably in other importing countries

of the second rank there were larger crops due in great part to increase in area under the influence of the depression in export crops and the efforts of the Governments concerned to stimulate domestic food production.

Amongst the major exporting countries only Burma, therefore, with its strong position in the Indian market, finds itself this year in a more favourable situation. Its new preferential advantage in the United Kingdom is largely offset by a deterioration of the position in continental markets. In China and the Far Eastern market generally the position has, from the point of view of the exporting countries, seriously deteriorated; given the above-mentioned position of Burma, however, this will react most severely on French Indo-China and Siam, which normally, and especially in the latter case, market the great bulk of their surplus in the Far East.

As regards the trade in high-quality rices the general conditions of depression in purchasing-power and of increased taxes on the product in European markets lead to the expectation of still more acute competition amongst exporters of these qualities.

BANANA CULTIVATION.

BY

PROFESSOR J. SYDNEY DASH, B.S.A.

This paper is not intended as an exhaustive treatise on the subject of banana cultivation. An effort, nevertheless, will be made to cover the more important points in that connection, special reference being made to the work which my department has been endeavouring to do. At the outset a word or two as to how the College came to be interested in banana projects may not be out of place. It was largely due to the initiative of Sir Francis Watts, who, becoming impressed with the rapid spread of Panama Disease affecting Gros Michel, the principal variety exported in these parts, solicited the interest of the Colonial Office and suggested the possibility of raising varieties from seed with the hope of finding something resistant. The United Fruit Co., one of the largest concerns directly interested in the banana business, has been studying the disease problem for years, much of their work being centered round the search for and testing of resistant varieties for their commercial possibilities. Such varieties do exist (see *Tropical Agriculture*, Vol. I, No. 11, page 172) but so far none has been found with the outstanding commercial characteristics of Gros Michel. Obtaining varieties from seed is a phase that has been taken up by the College, hybridization work having been started by Professor Mason in the autumn of 1922, when he had at his disposal plots of the common edible bananas at St. Augustine and certain seeded forms at St. Clair. I need not give the details of these results which were embodied in a paper by myself (having taken over the work in its later stages) read at the Jamaica Agricultural Conference early last year and which will be published in due course. One of the hybrids obtained is at present fruiting. In addition to this work a banana collection has been brought together and studies are also in progress on types of suckers, their fruiting values, dates of planting, pruning and shipping tests. The whole banana question is now in the hands of a committee comprised of the Principal, the Professors of Botany, Mycology and Agronomy and the Director of Agriculture.

1.—HISTORY AND COMMERCE.

The banana is thought to be indigenous to Asia and Africa and was first brought to America, it is supposed, from Spain, early in the 16th century and planted in the island of Santo Domingo, from where it spread to the surrounding islands and mainland. There is a strong belief, however, that two species of the banana were cultivated in Tropical America before the coming of Europeans. The Gros Michel banana is recorded as being introduced into Jamaica from Mar-

*This is a copy of an address delivered to the Trinidad Agricultural Society embodying the results of field investigations undertaken by Professor Dash at the Imperial College of Tropical Agriculture in connection with varieties, propagation, time to plant and prune, etc. It is in view of the interest being taken at present in the banana industry in British Guiana that this address is here reprinted from "*Tropical Agriculture*", Vol. II, No. 7.

tinique in 1836. The first importation of bananas into the United States is given as taking place in 1804, when thirty bunches were carried from Cuba to New York. In 1830 there were 1,500 bunches, but it was not until the formation of the United Fruit Co. in 1899 that the industry really assumed large proportions. The following tables give the imports and their values into the United States and the United Kingdom from the principal producing countries for the years 1913 and 1922. The figures show the increasing importance of the banana trade in which it is earnestly hoped the Colony of Trinidad and the neighbouring islands at no distant date will be able to participate.

IMPORTS OF BANANAS INTO THE UNITED STATES.

Countries of Origin	1913	1922
	Bunches	Bunches
Costa Rica	6,973,634	3,704,727
Guatemala	2,359,250	4,498,800
Honduras	7,983,591	14,584,674
Nicaragua	1,681,944	2,603,491
Panama	4,438,300	3,665,378
Mexico	1,541,504	739,186
Cuba	2,213,733	1,808,872
Columbia	2,684,749	2,205,538
British Honduras	651,064	460,825
British West Indies (chiefly Jamaica)	11,164,8[illegible]4	10,689,186
Other Countries	664,396	134,215
Total Quantity, Bunches	42,357,109	45,094,892
Total Value	$ 14,484,258	$ 19,145,911

IMPORTS OF BANANAS INTO THE UNITED KINGDOM.

Countries of Origin.	1913	1922
	Bunches	Bunches
Canary Islands	2,138,080	2,645,444
Republic of Honduras	——	1,185,492
Costa Rica	2,614,186	1,228,059
Columbia	2,255,504	4,163,695
Other Foreign Countries	32,451	3,507
Total Foreign Countries	7,040,221	9,226,197
British West Indies (chiefly Jamaica)	499,763	1,804,963
Total Quantity, Bunches	7,539,984	11,031,160
Total Value	$ 2,172,688	5,315,109

2.—Relationship and Structure.

In this discussion we are little concerned with the botany of the plant in all its aspects; suffice it to say that the genus Musa to which the banana belongs is a fairly large one containing many species. Among its near relatives are the Traveller's Tree (genus *Ravenala*) and the *balisier* (genus *Heliconia*) of the cacao orchard. On the other hand, some knowledge of the general structure of the plant is necessary to understand how to deal with it agriculturally. As in all plants, there is the root, stem, leaves and flowers.

Root.—Comprising the root system, there are generally speaking both horizontal and vertical roots, the latter often going to a very considerable depth—4 feet in Gros Michel, the horizontal 2 to 3 feet. The main roots are fleshy and cord-like—to secure the plant in the ground—from which the finer feeding roots are developed. Under favourable conditions, the fleshy roots grow rapidly. Fawcett records 2 feet in a month in Gros Michel and has traced them to a distance of 17 feet from the stem.

Stem.—The trunk we see carrying the leaves is not the true stem, but leaf tissue forming a pseudo-stem, the true stem being the bulb or rhizone from which roots and suckers are developed and which is the storehouse of the plant. From this also springs the fruiting stalk which pushes its way through the cylinder of leaf tissue forming the trunk, and eventually produces flowers and fruit. On the size and food stored in the bulb will depend the size of the bunch; if too many suckers are allowed to drain its reserve the bunches will be small.

Leaves.—As practically the whole plant seen by the eye is leaf structure, no wonder it is a rapid grower producing more food in proportion to the area occupied than many of our chief staples. The leaf blade it will be noticed is entire and not adapted to windy situations like the coconut with its divided leaves. Exposed to high winds the plants suffer, tall varieties like Gros Michel or Giant Fig being broken or completely blown over.

Flowers.—There are three kinds of flowers; the female or pistillate with long ovaries which produce the future bananas; the neuter or hermaphrodite found midway on the stalk forming short and useless fingers; the male with very small ovaries and much pollen found at the end of the stalk. Each cluster or hand has its own covering or bract which falls off as its protecting work is over. Gradually the young fruits turn upward as the stalk with bunch assumes a pendulous habit. It takes the bunch from three to six weeks to make the passage from the bulb to the apex, and from 2½ to 4 months after shooting before the fruit is full, the longer time being taken in the dry season.

3.—Varieties.

Only those of any merit commercially will be mentioned. Successful carriage, it should be pointed out, depends on several factors—ability of the fruit to handle well, strong central stalk, compact and not straggling bunch, with imbri-

cated hands and close-fitting recurved fingers, not easily damaged or broken off. The outstanding one in this connection is Gros Michel, so susceptible to Panama Disease. Resistant ones under observation are:—Congo, Grenada Giant Fig and Surinam Bumulan. The Congo has already been tried by the United Fruit Co., its poor shipping qualities have practically ruled it out as a substitute for Gros Michel. This is unfortunate for it is a heavy producer and a good type of tree, being midway in size between Gros Michel and Governor. It appears to be the same banana referred to in Jamaica as Robusta and as Porto Rico banana in Dominica. The Grenada Giant Fig is a variety of great promise: it is too soon to say how far it can take the place of Gros Michel but it would seem to be the best of those so far tried. The flavour is excellent while its ability to carry and ripen attractively are still subjects of investigation. The Bumulan appears to be in the same category, likewise the St. Lucia Giant Fig or Bout Rond. We have all these under observation at present with a view to determining definitely their relationship and qualities.

The Claret banana possesses some value commercially and is being grown by the United Fruit Co. to some extent in replacing Gros Michel attacked by Panama disease. The price of this fruit is good but there is a very limited demand.

The Canary or Dwarf banana, also known as Chinese or Cavendish, and locally as Governor Fig is the banana grown in the Canaries for European markets. It may be found in many parts of the tropics and sub-tropics where conditions are suitable for its growth. It is cultivated in Fiji and Queensland on a commercial scale, and being dwarf in habit is not much affected by winds and cyclones. It is also resistant to Panama disease and is the earliest maturing variety, but as special facilities have to be provided in the way of packing and crating, it becomes costly to handle when grown at considerable distances from markets and is not favoured by shipping companies; moreover, the American consumer, a large factor in the trade, appears to be wedded to Gros Michel type.

In our variety collection, already referred to, will be found a number of interesting types which have been obtained so far only in the West Indies and the Guianas. Some represent the remains of a collection originally obtained through Kew from the East many years ago and distributed to the various Botanic Stations, where Panama disease in several instances depleted their ranks. Several appear to be the same thing under different names, Gros Michel included. It is planned to make a careful study of all Gros Michel material, including that obtained from the different districts of Trinidad and the other islands now represented in the collection.

4.—Soils and Climate

The best soil considering the type of root system would be a deep, well drained but retentive loam, with a large proportion of humus. The banana actually flourishes on a wide range of soils providing there is good drainage,

thorough tillage and ample moisture with adequate attention to keeping up supplies of organic matter. Rich alluvial soils are very suitable, apart from being extremely fertile, the physical and mechanical condition of such soils is especially favourable to bananas.

As to climate, in Central America where the Gros Michel is cultivated, the best locations seem to be a few miles in from the sea, elevation of not more than 250 feet, rainfall 80 to 200 inches. In Jamaica, on the North side the rainfall is 90 inches per annum and on the south side bananas are grown by irrigation. In the Canary Islands irrigation is practised with the Dwarf banana ; this, however, is less exacting in the matter of moisture, and good bunches can be produced even in this district of St. Augustine where the rainfall is around 60 to 65 inches, and the country side swept by high drying winds in the dry season. These climatic conditions, therefore, are certainly not the best for Gros Michel or Giant Fig, if a high percentage of nine-hand bunches is to be obtained. Windbreaks, heavy manuring and mulching will be essential to ensure even the smallest measure of success.

5.—PROPAGATION.

The banana plant produces two types of suckers (1) broad leaved suckers which from the beginning produce leaf blades of the same general form as those of the adult plant and known as maiden suckers ; (2) narrow leaved or sword suckers, producing small narrow blades at first, later changing and taking on adult foliage. The former usually arise at the top of the parent bulb and at an early time develop their own roots, but show little bulb growth compared with the sword suckers which originate deep in the ground, often underneath the parent stock from which they draw nourishment and thicken out before beginning to show much above the ground. This type is usually preferred for planting and, in Jamaica, they are allowed to reach the age of 6 to 8 months when they are cut back to within 6 to 8 inches of the bulb and the roots trimmed off. A side bud from this is allowed to develop into the new plant, growth from the central bud not being particularly favoured, the tendency being for this to produce a smaller bunch even though early. At the College we have tried out on a small scale the different kinds, namely, 6 to 8 months old suckers cut back, typical swords about 3 feet tall untopped, and young adult or maiden suckers (broad leaves). We have been impressed with the remarkable vigour of shoots from large side buds on the bulbs ; in several instances, three months were sufficient for them to catch up to the sword which required a little more time to get started. In Jamaica, these bulbs are frequently left to dry out for three or four days before being planted or sometimes piled in heaps and covered with trash for a month, when those showing the most prominent buds are selected. In Central America, the United Fruit Co. usually cut up large heads into pieces weighing 3 to 4 lbs. each with at least one good eye, which are planted with the cut surface up. Bulbs cut up in this way may be better examined for pests and disease, if such are prevalent.

From observations on the Gros Michel and Dwarf varieties, we see little in the end to choose from at present in either untopped sword suckers or bulbs except that the latter are undoubtedly preferable for securing a better anchorage in the ground—very essential in windy situations—and may be considered as more reliable in unfavourable soil and weather conditions. On the other hand, the former may produce good bunches earlier than side buds from bulbs, but not earlier than heartbuds from bulbs, these last, however, tending to give smaller bunches. For these reasons, tall swords appear to be preferred in Jamaica for supplying established fields or for planting in protected situations.

In starting up new plantations where material is scarce there is often little choice ; under such conditions resort must be had to nurseries—especially too if Panama disease is a factor to be reckoned with—where only the cleanest disease-free suckers should be collected. This applies with particular force in the case of Gros Michel. Where the banana weevil is bad, suckers with little bulb development may prove advantageous for nursery purposes, as it is principally in the older fleshy rootstocks that the insect multiplies. In any case, all planting material should be soaked in water, preferably for 48 hours, as a precautionary measure which will be found reasonably efficient. Great care should be taken of the nursery so that the plants may develop as rapidly as possible and produce a large percentage of good suckers for final setting out in the field. Mr. Scudamore of the United Fruit Co. who visited these islands sometime ago is reported in a Grenada paper as saying that with an expenditure of £12, one acre of nurseries planted 6 feet by 3 feet (2,420 plants) would when grown—be sufficient to set out 6 acres of bananas 11 feet by 11 feet.

6.—Preparation of Land.

This should be attended to very carefully. Unless grown in virgin soil, deep ploughing—if possible subsoiling—will be found most profitable. The growing of a vigorous cover crop will also be useful as a weed control measure and for supplying humus. Soils deficient in lime should be supplied with this element. The roots of the banana plant are soft and fleshy and for that reason thorough tillage is necessary for their active growth and spread—both of which contribute to the vigour and productivity of the plants. Sound agricultural methods on the lines practised for sugar-cane with which it could be grown as a rotation crop where the rainfall is suitable are recommended. Proper drainage too is absolutely essential. These operations completed, holes for the reception of the suckers must be dug. These should be wide and deep so that the vertical roots may penetrate deeply and secure a firm anchorage.

Plants are frequently blown over even with ordinary winds when planted too shallow. We usually dig our holes 2½ feet square and 2 feet deep, keeping the surface soil separate from the subsoil. Pen manure is then mixed with the former and the holes filled about half way for some days before planting. In

Jamaica, wide planting is advocated, although the distance varies with the district, 14 feet each way being favoured. At this distance, some planters put two suckers to the hole with the hope of getting an extra large return from the plant crop, but it is not the usual practice; in this connection much depends on the fertility and moisture conditions. We have adopted at the College a distance of 12 feet by 12 feet for Gros Michel and Giant Fig; this suits our drainage system, the land being divided into 36 feet beds which just gives three plants in width. These beds would hold four plants of the Governor in width, if planted 9 feet by 9 feet. The suckers are carefully placed in the centre of the holes with the soil and manure firmly pressed around them; where bulbs are used, the tops should be covered with at least 3 inches of earth. If bananas are planted as ground shade for young cacao trees adequate attention must be given to all the points raised if large bunches for export are required.

7.—Time to Plant and Prune.

Time to plant will depend somewhat on the weather conditions, but if late winter and spring markets are aimed at, early planting is favoured. In Jamaica, Gros Michel is usually planted in March and April, May rains (or irrigation) being relied on to start the plants so that fruit may be obtained in ten to twelve months' time. In Trinidad, the dry season cannot be depended on to produce very effective showers and such early planting may not be generally satisfactory. We are now testing out this point by planting bulbs in every month of the year, commencing last January. While too early to make any definite pronouncement indications are that where this type of sucker with large stores of reserve food is used, provided it is free from weevil and disease, the plants have a better chance of coming through. At the present time, however, we are in a position to report results from June and October plantings previously made. Suckers of good type put in during October 1923 produced mature (marketable stage) fruit in from 11 to 14 months—Giant Fig slightly ahead of Gros Michel, while small maiden suckers (not recommended) of Gros Michel took 16 months to yield similar fruit. Planted in June 1924, Gros Michel has given fruit in 9 to 10 months, small maiden suckers producing smaller bunches than either bulbs or swords. The maiden suckers may therefore be discarded with confidence as not being the best for planting.

It would appear from these trials that late planted not only developed slower but produced smaller bunches than June planted which under our conditions may be expected with good cultivation to produce fruit about March and April when the demand is best. As the season extends from January to June, by arranging plantings from late May to mid-July, fruits from plants should be coming in over the period March to June. We have next to consider the timing of suckers as followers to succeed the parents and which may be expected to supply fruit for January and February. Sufficient data have not yet been obtained on

which to base a definite statement. It is known, however, that followers take a little longer than plants and we have noticed that the dry season has a retarding effect. Present indications are that a sucker coming out of the ground about October should produce fruit in 15 to 16 months, that is about January-February, and if another sucker is left four months after, fruit might be expected from it about May-June. (Ratoons tend to produce later and later with age and are more difficult to time.) Thus, a regular sequence of bunches would be provided for in season, the full effect not being realized until the third year. The order of procedure suggested, therefore, is as follows: plant late May, June to early July not later; prune off all suckers around the strong leading plant until October, then leave one just coming out of the ground; then leave another on the other side four months later always retaining suckers of the sword type for fruit The policy after that would depend to some extent on the length of time (preferably 4 to 6 years) before replanting, but in general, keeping three suckers to each clump in the manner suggested seems advisable, unless soil and climatic conditions permit more with profit. In this connection maximum prices it will be noted are only paid for nine-hand bunches, a high percentage of which can only be obtained by careful pruning. In this operation the suckers not wanted should be taken out low down else they will grow again and if later selected for fruit will prove disappointing. They should be removed when not more than 1 or 2 feet high, applying the cutlass with the point away from the mother plant so as not to injure it. Followers should be left in such a position that they will not be damaged in case of an older trunk in the same clump falling over. An effort, too, should be made to keep the clumps in their original lines to permit of easy cultivation by implements.

8.—After-treatment.

Cultivation.—Next to timing and pruning in importance comes the management of the soil during the life of the plantation. In the early stages of its existence, temporary crops may be grown either as nurse crops to give protection from wind or for mulch and weed control. We have found pigeon-pea, thickly broadcast, useful in this connection; when three months old, most of it should be cutlassed to form a mulch, a few plants being retained as temporary wind-breaks. As a low growing cover crop, we have also tried peanuts successfully. It must be emphasized that such practices can only have very limited application or the soil may be robbed of some of its fertility and moisture which will be needed later for fruit formation. The straw mulch is especially recommended in situations of low rainfall, particularly in the dry season, a thick one helping to keep down weeds, trouble from which may be anticipated under most conditions unless extraordinary care has been taken in the preparation of the land before planting. From a heavy smother crop like Bengal or Sword Bean the greatest service will be obtained if sown in thrown-out fields, when the vines will cover the old stumps and suckers, thus hastening their decay, the whole mass being turned in and allowed to decompose a little time before the field is replanted.

The question of tillage will have to be envisaged, its nature depending on the type of soil. If light and friable, shallow cultivations only will be necessary and these infrequently; at the College, a light forking 4 to 6 inches deep has so far been given twice a year with advantage—before mulching and again and as soon as the rains come in. With heavy soil, deeper cultivation and even subsoiling may be found necessary to break it up periodically, thus ensuring proper drainage and giving the feeding roots more freedom. Cutting through the roots seems to do no harm but rather stimulates them into greater activity; if done frequently too close to the plants a check may be given to any bunches in course of formation. A series of experiments on this question of tillage on heavy soils in Trinidad should yield most valuable results.

Manuring.—Nothing has so far been used in the College plots but farmyard manure. Some of our mulching material consists of strawy manure and waste of various kinds. The conclusion arrived at in Jamaica as the result of experimental work is that bananas do not require fertilizers; humus, lime and drainage are the chief factors of practical importance. As to liming, this would appear to be necessary especially where Panama disease is present and under Trinidad conditions attention will have to be given to it. Ground limestone at the rate of 2 tons to the acre would constitute a fair dressing applied every four years, that is at replanting time.

Pruning leaves.—As the older leaves cease to function actively they tend to fall and hang around the trunk. It is better not to remove them all as they help to protect the pseudo-stem from the drying effects of the sun and wind. In closely planted groves they may have to be regularly trimmed off along with some of the living green leaves if there is a tendency to too much shading. As a general practice, remove no leaves unles they have entirely dried up. Watch should be kept for any leaf which by its position is liable to cause injury or discolouration to a bunch when it should be carefully pruned off.

9.—Harvesting.

In this operation the top of the plant is partially cut about 5 to 6 feet from the ground to allow of its gradual fall. With the weight of a bunch (50 to 60 lbs.) attached, care is necessary to prevent damage or injury to neighbouring plants. The bunch is caught and severed, then wrapped in trash to prevent bruising during its carriage to the collecting bases for grading prior to disposal. Every precaution must be taken in the handling of fruit for shipment, which is usually cut about three weeks before it is ripe and when the fingers are still slightly angular. A little practice soon enables one to judge when a bunch is ready for harvesting.

The stems and leaves of the old plants are finely cut up and spread over the soil; the old stump is left to dry out before being removed, as any moisture it contains is beneficial to the remaining plants. If left too long, however, it may

harbour weevils. Care is necessary in its removal so as not to injure the plants or expose the soil too much, the hole being filled in immediately. Sometimes, young shoots are given off from small corm-like tubers on these old root stocks; they should never be retained for fruit, being in the category of maiden suckers.

10.—PESTS AND DISEASES.

A complete discussion of the pests and diseases of the banana does not come within the scope of this paper. Two of the worst troubles, namely, Panama disease (*Fusarium cubense*) and banana weevil (*Cosmopolites sordidus*) have been referred to and certain lines of action recommended in dealing with them. In the case more particularly of Panama disease, any signs of wilting plants should be promptly reported to the agricultural authorities so that competent advice may be given. In Jamaica, rigid quarantine and isolation measures have been enforced and a large number of inspectors employed to deal with cases. A number of other pests and diseases are met with, but so far as the West Indies are concerned they may be regarded as of minor importance.

11.—RETURNS.

It is usual in dealing with the question of yield to speak in terms of "payable bunches" or "straights", that is, bunches of nine hands. For the export trade, eight-hand bunches are considered as three-fourths the value of nine-hand, seven-hand one-half and six-hand one-fourth. Under ordinary conditions it is hardly probable that an average yield of 250 "straight" bunches per acre per annum will be exceeded. In this connection, plants will yield a lower percentage of such bunches than first ratoons. In a good banana section in Jamaica it is reported possible to get 330 "payable" bunches over a seven-year period. Under those conditions 66 to 70 per cent. of the plants and 88 to 90 per cent. of first ratoons give "straights". I have no doubt that in some parts of Trinidad it might not be difficult to secure such yields: in the vicinity of St. Augustine even 250 seems entirely out of the question. In our first trials only a very small number of plants gave nine-hand bunches, increasing in the first ratoons in the case of Giant Fig to between 30 and 40 per cent. From the acre now being planted to this variety at the College, it should be possible to collect more data in regard to this particular point. Future success will depend on how far these soils can be converted into real banana land by additions of large amounts of humus that will absorb and retain the annual precipitation which is below that required for the most profitable commercial banana production. In addition, there is the wind factor to be considered.

Mr. Scudamore of the United Fruit Company when in Grenada gave as the cost of bringing one acre to bearing in Jamaica as £15. Figuring on 250 count bunches at 2s. (the average price in Jamaica over the past 20 years 1s. 8d.) the return would be £25, leaving a profit of £10 per acre. He estimated the cost in Grenada over a three-year period including cost of cultivation, reaping and trans-

port as £42 per acre, which, if it yields 750 bunches at 2s. in the three years would give a gross return of £75. Deducting £42 we have a net profit of £33 or £11 per acre per annum. Figures recently published by the Department of Agriculture, Trinidad, show the cost locally to be about £13 per acre on land which has been under cultivation to other crops.

The utilization of inferior fruit for subsidiary banana products is worth considering in any development of commercial banana growing. Some of the more important of these are banana chips, meal or flour, banana "figs" or evaporated bananas (the Governor is better for this purpose than Gros Michel) and alcohol. From the sheaths, banana fibre may be obtained and there are also possibilities in the pulp for paper, while the stalks and skins are rich in potash and of considerable value as a manure. It is naturally a problem in economics as to whether any or all of these will be profitable.

REPORTS.

THE COLONY FLOODS.

Meteorological:—The floods of January, 1934, are without parallel in the period for which meteorological observations and particulars of rainfall are available for the Colony. When, however, one comes to examine the rainfall figures of the period during and immediately preceding which the major disasters occurred, it is seen that few record quantities of rain fell in any given time, but that the abnormal surplus of water was due rather to a steady continuance of wet weather, culminating early in January in one very heavy precipitation over a period of less than 24 hours. The coastlands, prior to this, were already in the water-logged condition associated with a heavy wet season, and many areas were then partially flooded. Unfortunately at this period the concurrence of spring tides hampered the run-off of water, and with the addition of an abnormal precipitation such as occurred on the night of January 7-8, widespread flooding of a serious nature was inevitable, the effects of which were considerably magnified owing to breaches occurring in the dams of the East Coast Conservancy.

The year 1933 was a wet year, and the following figures taken from the Botanic Gardens records may be considered representative of conditions generally. The total rainfall was 116.55 (the mean for the last 52 years being 87.84). During the first dry season there was only a short period, in April, when no rain fell, and May, June and July were as usual wet months, followed by an abnormally wet August in which 14.45 inches fell, only .31 inches below the record for that month (14.76 inches in 1910). After rain had continued to the end of August, an unusually short dry season followed, and the wet weather set in again in the last week of October, giving a total fall of 4.15 inches for that month, for which the mean rainfall is only 2.59 inches. November was again abnormally wet, with 10.40 inches as opposed to a mean of 5.59 inches, and finally in December, 27.10 inches fell, a total for that month which has only once before been exceeded (32.38 inches in 1891). The rain continued into the New Year; 4.10 inches fell on the 3rd. January, 1.15 inches and 1.25 inches on the 5th and 6th and finally 7.16 inches fell on the 7th—this precipitation occurring actually between 8 p.m. on that day and 7.15 a.m. on the 8th. Over an inch a day fell for the next 5 days, making a total of 24.79 inches on the 12th of the month, after which the rainfall was slight. The total fall for January, however, 28 inches, was a record.

On examination of the rainfall figures for December 1933 and January 1934 together, the very heavy and accumulated rainfall becomes apparent. The total rainfall for December and January at the Botanic Gardens was 55 inches—the mean *annual* total is 87.84 inches. Starting with a fall of 5.12 inches on Decem-

ber 17, a total of 42.45 inches fell from that day to January 12, inclusive, *i.e.*, during a period of just under four weeks. Up to and including January 12, 24.79 inches had fallen since the beginning of the month, an average of over 2 inches a day.

DAILY RAINFALL AT THE BOTANIC GARDENS, GEORGETOWN, DURING DECEMBER, 1933, AND JANUARY, 1934.

December 1933.		January 1934.	
Days.	Inches.	Days.	Inches.
1	.07	1	.78
2	...	2	.91
3	.61	3	4.10
4	1.48	4	2.69
5	...	5	1.15
6	.03	6	1.25
7	1.33	7	7.16
8	.43	8	1.08
9	1.95	9	1.02
10	2.25	10	1.22
11	...	11	1.75
12	.67	12	1.65
13	.56	13	.28
14	...	14	.02
15	...	15	.41
16	.06	16	.52
17	5.12	17	.19
18	2.28	18	...
19	.09	19	.03
20	1.77	20	.12
21	1.14	21	.08
22	1.55	22	.22
23	1.37	23	.25
24	1.01	24	.05
25	.02	25	.22
26	.03	26	...
27	.80	27	.03
28	.16	28	.30
29	.40	29	.19
30	1.40	30	...
31	.52	31	.30
TOTAL	27.10		28.00

The fall on the night of January 7-8 is the second highest recorded fall for a period of 24 hours, 8.32 inches being measured on April 9, 1890. The latter fall, however, and several other high precipitations to be found in the records, were

neither preceded nor followed by such heavy and continuous rain as in this year. It may also be noted that one or two other gauges within a mile or so of the Botanic Gardens, recorded over 8 inches for the period in question. (Table shows the daily rainfall at the Gardens for December 1933 and January 1934.)

When one comes to study the rainfall returns from other parts of the Colony it is apparent that the abnormal rains of the first week in January are confined, on the coastlands, to the region between the Berbice and Moruka Rivers. The Corentyne Coast and the North West District received no unduly heavy precipitation for that time of year. It is also interesting to note that the heaviest rain fell in the Pomeroon on the night of the 6th, on the Essequibo Coast on the morning of the 7th, and in Georgetown and on the East Coast on the night of the 7th.

Returns from the various stations up and down the coast show some remarkably heavy totals for the 24 hours when the worst rain fell. The northern part of the Essequibo Coast between the Essequibo River and Moruka suffered in particular. Anna Regina recorded 10.37 inches on the 7th, Hampton Court —12.10 inches, and the highest fall of all was measured on the 6th at the mouth of the Moruka—14.84 inches, followed by 7.07 inches the next day. On the other hand Onderneeming had only 2.53 inches on the 7th.

The West Coast records show, amongst others the very large totals of 30.75 inches at Boerasirie and 21.23 inches at Warimia, in the Conservancy, from January 1 to 13 inclusive, although the rainfall shown there on the 7th was not out of the ordinary. Some of the East Coast estates however, received like Georgetown a fall of 7 inches and over on the night of the 7th, but east of Mahaica no abnormal rain fell that night. For instance on January 6, 7 and 8, Pln. Cane Grove recorded 1.42, 3.70 and 3.62 inches, and the Lama stop-off 1.31, 4.82, and 3.54 inches, with a total of 14.38 and 21.11 inches respectively for the first 10 days of January. A fall of 4.61 inches on the Bath backdam was the highest record for Berbice at this period, and Fort Wellington had very little rain. Mahaicony only recorded 0.53 inches for the Sunday night so wet elsewhere. This latter return though, and other similar low records, are quite in keeping with the extraordinary variations in rainfall that constantly occur along the coast between places situated quite close together.

To sum up the above rainfall figures, it would appear that a very heavy rainstorm, or series of storms, struck the coast line somewhat to the north of Moruka mouth on the afternoon of January 6, and passing south-east, caused an abnormally heavy precipitation during the next 24-36 hours as far as the Mahaica creek. Beyond this, the rainfall seems to have tailed off, the amount registered in East Berbice being no more than normal. The abnormal flood damage, however, was due rather to the previous accumulation of water in the conservancies and savannahs, which the final downpours caused to overflow and burst their dams, the unfortunate occurrence of spring tides at the same time hampering the run-off of the flood waters.

Damage:—The sugar industry is estimated to have lost approximately 20,000 tons of sugar in addition to considerable financial loss through charges for extra pumping, raising dams, and expenditure for rehabilitation works. The loss to the rice industry is estimated at about 30% of the output; some of the late autumn crop was damaged by the early rains, the spring crop was almost completely destroyed, and much padi was damaged in the factories and storehouses. Ground provision farms, notably in East Demerara and the Pomeroon, suffered severely, while the loss to permanent crops such as coffee, avocado pears and other fruit trees was, in some instances, extensive. In Plates V and VI, figs. 8-13, some indication is given of the widespread damage.

PLANTING MATERIAL DISTRIBUTED—FEBRUARY-MARCH, 1934.

DISTRICT	Blackeye Peas	Eddoes	Yams	Tannias	Tannia Bottoms	Sweet Potatoes	Sweet Cassava	Bitter Cassava	Sweet Potato Cuttings	Tomato Seedlings
	Bags	Bags	Bags	Bags	Bags	Bags	Ctgs.	Ctgs.		
East Demerara	37	53	4	17	51	29	15,000	36,000	15,000	4,000
West Demerara	7	6	4		4		28,500			
Berbice	10	6		6						
Essequibo	11	23	1	12	8	27	12,500	5,000		
N.W.D.	10									

The Department has vigorously co-operated in flood relief measures and planting material of quick-growing food crops were telegraphed for, received with the minimum delay, and distributed in those areas where the loss was heaviest. Thus the Department obtained seed of selected black eye peas through the United States Department of Agriculture, sweet potatoes for planting material from Trinidad, and collected material from those areas of the Colony, (*e.g.*, the North West), where cultivations had not suffered severely. The planting material was distributed by the District Agricultural Officers and every attempt made to see that these were used to best advantage.

Further, the Department organized special agricultural competitions in connection with these flood relief measures. Money prizes are being awarded in the coast villages for quick re-establishment of cultivations and in the North West District for extension of ground provisions and coffee. Altogether the sum of $1,230 has been allocated for these special awards. The above table gives indication of the planting material of some of the more important crops distributed by the Department of Agriculture.—E.B.M.

FIG. 11.—A small cultivator's farm still under water a week after the floods aback of Golden Grove, East Coast Demerara. In the foreground a young banana plant is almost completely covered and in the background are growing pine apples.

FIG. 12.—A rice factory on the West Coast of Berbice. The concrete drying platform is completely under water and it is evident how the lower tiers of padi stored in these factories were substantially damaged.

FIG. 13.—Dams hastily raised by mud bags at Buxton, East Coast Demerara, to keep flood waters out of the village. In the background are the lands of Pln. Lusignan and the chimney of that estate is faintly visible.

DISTRICT AGRICULTURAL COMMITTEE MEETINGS.

In his 1930 Administrative Report (p. 29) the Director of Agriculture states: "It is necessary that.......District Agricultural Committees be appointed in the various districts. Each Committee should consist of five to seven of the best agriculturists in the district forming advisory bodies to the Department and controlling district agricultural activities generally, in close collaboration with the District Agricultural Officer and the Commissioner of the District."

These proposals were approved of by His Excellency the Governor and the following members of the East and West Demerara District Committees were present at the first meeting, the proceedings of which are summarised below.

Meeting of District Agricultural Committee, East Demerara, (March 5, 1934.

Prof. the Hon. J. S. Dash	....	Director of Agriculture (Chairman)
Mr. M. B. Laing	....	District Commissioner.
Mr. W. H. Richards,	....	Manager, Pln. Lusignan
Mr. S. Andries, J. E. Wills		
Mr. Mohamed Ghani	....	
Mr. E. M. Peterkin	....	Agricultural Superintendent (Secretary)
Capt. F. Burnett	....	Deputy Director of Agriculture (Co-opted)

Meeting of District Agricultural Committee, West Demerara, (March 9, 1934).

Prof. the Hon. J. S. Dash	....	Director of Agriculture (Chairman)
Mr. W. A. Macnie	....	District Commissioner
Mr. A. Murison	....	Manager, Pln. Uitvlugt
Mr. R. B. Hunter	....	Manager, Pln. Versailles
Mr. A. Rayman	....	
Mr. W. Ramdeholl	....	
Mr. J. C. DaSilva	....	
Mr. J. W. Jackson	....	
Mr. E. M. Peterkin	....	Agricultural Superintendent (Secretary)
Capt. F. Burnett	....	Deputy Director of Agriculture (Co-opted)

Among the important items that arose for discussion were :—

(1) SCOPE AND PROPOSED ACTIVITIES OF THE COMMITTEES.

It was agreed that each committee should restrict its activities to the District for which appointed. The Chairman outlined the following as being among the important lines of endeavour of the Committees:—

(1) To develop food production ;

(2) To develop new agricultural products of export value, specially suitable to the soil of the district ;

(3) To make suggestions for the organisation of agricultural industries of small cultivators ;

(4) To report on marketing facilities, supplies of seed, manures, etc.
(5) To report the outbreak of any plant pest or disease;
(6) To assist in the organisation of co-operative credit societies;
(7) To make suggestions for the regulation of agricultural shows and competitions;
(8) To discuss agricultural questions affecting the interests of members.

(2) THE FLOODS AND REHABILITATION ACTIVITIES.

The Chairman reported that one of the first steps taken was to collect, as quickly as possible, reliable information on the flood damage in order accurately to assess the loss; in this connection the District Commissioners, the District Agricultural Officers, the sugar estates' authorities and farmers had given valuable assistance.

Ground Provisions and Vegetables.—Apart from the distribution of propagating material of the important ground provision crops (mentioned in detail elsewhere in this issue) attention was drawn to the fact that Sub-station Cecilia had been converted into a nursery for the rapid production of planting material and there had already been distributed 3,000 tomato seedlings 5,000 sweet potato cuttings in addition to seed of pepper, sinebone, lima bean, yard bean, cabbage, etc. It was further anticipated that boulanger and ochro seeds would shortly be available. Extra competitions were being run and substantial money prizes awarded by the Department in connection with the quick re-establishing of crops as well as for extension in areas not affected. The Secretary gave full details of the various distributions made.

Rice.—It was pointed out that owing to flood losses the amount of the Department's pure line seed available for distribution was limited. The Deputy Director explained the scheme which had been drawn up for the *pro rata* distribution of available stocks to farmers through mills and in some cases the Village Councils. This was discussed and approved. The chairman mentioned that plans were in hand by the Department for cultivation of 100 acres of pure line padi during the next crop in addition to the supplies normally grown at the Experiment Station and on Government blocks in the various districts. In this way, the deficiency this year owing to unfavourable circumstances should be fully met next year and increased supplies for the future built up. It was estimated that there would be 16,000-18,000 tons of rice available for export from existing stocks. This would be supplemented by the 1934 Autumn crop.

Sugar.—A sub-committee of the Flood Investigation Committee had been appointed to enquire into the losses suffered by the industry, and their report was being prepared for submission to Government.

(3) VISIT OF THE UNITED FRUIT COMPANY'S REPRESENTATIVE.

It was reported that due to the efforts of the Department of Agriculture a representative of the United Fruit Company would, during April, visit the Colony in order to discuss the possibilities of banana export since limited ventilated space would shortly be available on the "Lady" boats.

It was the general opinion that the East Coast lands were better suited to sugar-cane and that efforts with bananas were more likely to prove successful on the higher river lands, since drainage was essential to success in banana cultivation. Export bunches would have to be of a size not less than 7 hands and the variety wanted was Gros Michel. It was agreed that the first essential was to concentrate effort in one district where there was chance of success both from the point of view of production and transport facilities, and in this connection the Demerara River lands, where considerable interest and activity were already being shown, appeared to offer the greater possibilities:

The Director of Agriculture outlined in some detail to the West Demerara Committee the more important factors relating to the trade and indicated the Department's policy in connection with nurseries and distribution of planting material, supplies of which were limited as the banana cultivations in the colony were very mixed. He also stated that an article on banana cultivation would be published shortly in the Agricultural Journal.

It was agreed that Mr. Sanderson on his arrival should be shown as much as possible with a view to advising fully on the subject of an export trade, but at present it seemed clear that collection of bunches from small scattered cultivations all over the colony was not an economic proposition. A census was being undertaken by agricultural officers.

(4) EXHIBITIONS AND COMPETITIONS.

It was mentioned that the Colony Agricultural and Industrial Exhibition had been indefinitely postponed on account of the substantial agricultural loss resulting from the heavy rains. The Chairman announced that it had been decided that the Department of Agriculture would organise a purely Agricultural Show in Georgetown in September and he hoped that it would be energetically supported by all sections of the agricultural community. Full details were given of all the district competitions for 1934 by the Deputy Director.

(5) THRESHING MACHINES.

It was reported that experiments had been carried out at the Department's rice station and later in certain villages in co-operation with the District Commissioner, East Demerara, with threshing machines supplied through the Colonial Development Fund. Results indicated that the use of these machines had proved to be economical, but due largely to the low price of padi more of these machines

were not being bought and used in the industry. Suggestions were put forward and approved for submission to the agents and manufacturers; this it was hoped would lead to further developments in the use of these machines.

(6) Miscellaneous.

Cassava.—As there had been considerable discussion especially within recent months about the export of cassava, it was mentioned as a point worthy of interest that the Department of Agriculture had been in communication with a number of commercial firms who were interested. The best price quoted was $15.00 per ton for ~~picked,~~ sliced and dried cassava. This was considered too low to offer any hope of a successful export trade.

Coffee.—At the West Demerara meeting, the Chairman announced that he had summoned a meeting of the coffee exporters to discuss proposals for improving the prices received on export markets for British Guiana coffee. At that meeting it had been decided that the District Agricultural Officers should be supplied with samples of coffee of the main grades and that these samples should be used as a guide both to the officers themselves and the growers in the districts Messrs. Booker Bros., McConnell & Co., Ltd., had kindly supplied commercial samples of two grades, the difference in price for which was between a half and three-quarter cents per pound. It was considered that with this price incentive the coffee growers would be encouraged to improve the quality of the product with the minimum increase in cost of production. The Chairman displayed these samples and hoped the matter would receive the fullest publicity possible.

General.—Many other items of local agricultural interest were discusssed by members and the thanks of the Department were extended to those attending for the intelligent and helpful suggestions and proposals made.

The Chairman appealed to members to give as much assistance and encouragement as possible to agriculturists and officers of the Department in the districts. He further stated that he would be glad to receive suggestions for the agenda for future meetings.

E.M.P.

NOTES.

Marketing.—Marketing is an operation which always sounds delightfully easy. You have only to arrange for all your small producers to collect their produce at a certain place and a certain time and then, by virtue of the improved bargaining power which you get from handling a large quantity, and reduced costs of transport, proceed to sell it at an increased price. Actually, however, it is extremely difficult, as a very little experience soon shows. First the collection breaks down. Some of your producers are cut off by an impassable stream, many others have gone to a wedding and will bring their stuff to-morrow, when your lorry, or whatever it is, has gone, many more have been beguiled, by the sight of a little hard cash and the promise of more, into selling to the local trader, others are tied to the local boutique keeper, to whom they owe money. If they do not take their produce to him at his price, he will put them in court and sell their lands. But they never told you a word about this when they promised to bring their produce. Usually there is such a complete breakdown at this stage, that the whole scheme collapses. But if you surmount that obstacle, there are plenty more. Your individual member must have cash, and cannot wait for it. You can only afford to pay him a conservative fraction of the anticipated final price, but to do even this, you need a very large sum of money, which you have not got and cannot borrow, because no one will lend on the security of a lot of produce which has not yet been collected, to a society which will very likely collapse. You can hardly even guarantee that you will collect produce with sufficient certainty to justify Government in putting up a warehouse in which to collect it. If you get that far, you have next got to arrange to get it sold without illicit commissions, work out accounts of all transport and other expenses, and pay the balance due to the producers scattered all over the country. Throughout the whole transaction you will be dogged by the mistrust of the original producer, who has parted with his produce on a partial payment, and strongly suspects that distant people whom he does not know have cheated him or will shortly do so. Needless to say this suspicion and mistrust is actively fostered by the agency which formerly bought these goods, and has no desire to be ousted by your organization. On a co-operative basis all this has to be done by an association formed by the producers themselves, *i.e.*, cultivators pitted against traders, trying to beat them at their own game and oust them from a market which they already hold. Officials may help and advise, but if they actually do the work it is not co-operation, and they are going outside their province.—**W. K. H. Campbell** (Admin. Rep: on the Working of Co-operative Societies, Ceylon, from May 1, 1932, to April 30, 1933.)

Agricultural Legislation in British Guiana:—The following is the chief agricultural legislation enacted since the last issue of the Journal appeared in December 1931:—

1932.

1. Amendment of the Animals (Breed and Contagious Diseases) Ordinance (Ordinance No. 38 of 1932). The chief feature is that certain powers are conferred on the Governor-in-Council in cases of emergency.

2. Provision for the control of Sugar Experiment Stations (Ordinance No 41 of 1932). The chief features are :—

(*a*) Appointment of a Committee to be elected by the British Guiana Sugar Producers' Association and consisting of six persons immediately connected with the sugar industry with the Director of Agriculture as Chairman ;

(*b*) The Committee to establish and maintain such Sugar Experiment Stations as may be found necessary ;

(*c*) The Director of Agriculture as Chairman to have immediate control of the staff of the Experiment Stations; the officers of the Department of Agriculture to co-operate under the direction of the Director in the work of the Stations ;

(*d*) The Committee to collect a cess of not more than 30c. for each acre of land cultivated with sugar cane, charges to be made only where the area cultivated by one person exceeds 25 acres.

3. Provision for the establishment of a Board with powers to regulate and control the prices and exportation of rice produced in the Colony (Ordinance No. 47 of 1932). The chief features are :—

(*a*) A Marketing Board to be established with a specified personnel ;

(*b*) The Board to meet once a week to fix, the price of rice for export, to grant licences to exporters, and to revoke licences for contravention of the provisions of the Ordinance ;

(*c*) A fee to be paid to the Board not exceeding 2c. on every 100 pounds of rice for export under a contract of sale, and a fee of $20 for every exporter's licence ;

(*d*) A person unless he is the holder of a licence not to export rice ;

(*e*) No person to export rice at a lower price than that fixed by the Board ;

(*f*) Penalties for the contravention of the provisions of this Ordinance.

4. Amendment of the Rice (Export Grading) Ordinance (Ordinance No. 40 of 1932) and Regulations in connection therewith. The chief features are :—

(*a*) Rice not to be submitted for grading unless previously blended ;

(*b*) Qualified blenders to be appointed by the Director of Agriculture ;

(*c*) The consignor to pay at the rate of 1c. per package of 100 pounds and 2c. per package containing more than 100 pounds.

1933.

1. Amendment to the Rice (Export Trade) Ordinance (Ordinance No. 21 of 1933). The main purpose was to extend the operation of the existing Ordinance which ceased to operate after August, 1933.

2. Regulation relating to the export trade in rice (Rice Export Trade Regulations, 1933). The chief features are :—

(*a*) Fixing of prices of rice for export;

(*b*) Form of contract of sale in respect of rice for export;

(*c*) Registration with the Secretary of the Rice Marketing Board of the names of exporters' agents outside of the Colony ;

(*d*) Registration with the Secretary of the Rice Marketing Board of orders for rice for export ;

(*e*) The marking of the grade on each bag of rice shipped.

3. Regulations for the control of rice factories and the manufacture of rice (Ordinance No. 26 of 1933). The chief features are :—

(*a*) Padi not to be milled without a licence ; the fee for a licence to be $1 ;

(*b*) Permission to erect a rice factory granted only after authority has been received with reference to public health and sanitation ;

(*c*) The holder of each licence to keep books in regard to the quantity of padi received, name and address of every person from whom padi is purchased with the quantity purchased, etc. ;

(*d*) Receipts to be issued and counterfoils kept ; returns to be made twice a year in regard to the amount of rice handled ;

(*e*) The Director of Agriculture, or the Commissioner, or the Government Medical Officer of Health, or any person authorised, empowered to inspect the factory or any books kept.

4. The management and constitution of Co-operative Credit Banks (Ordinance No. 28 of 1933). The chief features are :—

(*a*) Government to appoint a Co-operative Credit Banks Board for the general superintendence of all Banks. The Director of Agriculture to be Chairman of the Board ;

(*b*) The appointment of a Registrar of Banks who will be Secretary to the Board and subject to the direction of the Board ;

(*c*) Rules for the registration, and cancellation of registration, of Banks ;

(*d*) Definition of powers of the Board ;

(*e*) Operation of the Banks ;

(*f*) Dissolution and winding up of all Banks ;

(*g*) Offences, penalties and legal proceedings.

5. The prevention of entry of dogs from Trinidad (Order-in-Council No. 468)

6. Inoculation of animals against Anthrax (Order-in-Council No. 763).

7. Control of the movements of all horses, mules and asses into or out of areas infected with *Mal de Caderas* (Order-in-Council No. 239).

8. Regulation of the sale of copra and the manufacture of coconut products (Ordinance No. 31 of 1933). The chief features are :—

(*a*) Copra products to be manufactured only by licensed persons; for the licence a fee of $5 to be paid.

(*b*) Each broker to be licensed ; for the licence a fee of $5 to be paid.

(*c*) Registration of all copra producers ;

(*d*) The sale of copra by the producer only through brokers ;

(*e*) Prohibition of export of copra save by brokers ;

(*f*) Prohibition of sale of copra by brokers to anyone in the Colony save to manufacturers ;

(*g*) Permission of the Governor-in-Council to be obtained for the export by brokers of more than 30% of copra received ;

(*h*) Establishment of a Copra Brokers' Board who may fix advances to be made by brokers to producers on the delivery of copra ;

(*i*) Keeping of proper books by brokers and manufacturers ;

(*j*) Duty on copra products to be 12c. on every gallon of edible oil ; 42c. on every 100 lbs. of lard substitute ;

(*k*) The minimum purchase price for copra paid by manufacturers to be fixed by the Governor-in-Council ;

(*l*) Standards of quality to be fixed by the Governor from time to time.

9. Rules for the sale of copra and manufacture of coconut products (Copra Products Sale and Manufacture Rules, 1933). These rules give details in regard to the form of licences, certificates of registration, etc., called for in the Ordinance above dealing with this subject.—**J.S.D.**

Visit to West Indies by Agricultural Adviser to Secretary of State for the Colonies :—In publication No. 170 of the *Colonial Advisory Council of Agriculture and Animal Health*, Mr. F. A. Stockdale, C.M.G., C.B.E., gives a report on his visit which was undertaken primarily to attend the West Indian Intercolonial Fruit and Vegetable Conference, Jamaica, October 17-24, 1933. From Jamaica Mr. Stockdale returned *via* Trinidad and Barbados so as to attend the West Indian Sea Island Cotton Conference (Trinidad, November 1-6) and meetings of the Committee controlling the West Indian Central Cane-breeding Station (Barbados,

November 8-10). Opportunity was also taken to visit and confer with agricultural officers and others in Grenada, St. Vincent and St. Lucia.

In his report Mr. Stockdale summarises the conclusions arrived at during the Fruit and Vegetable Conference and also gives succinctly the important discussions and decisions in connection with agricultural affairs in other Caribbean colonies.

Although it was not possible for Mr. Stockdale to come to British Guiana, an opportunity was afforded for "general discussions on development in British Guiana" with Professor Dash, who represented the Colony at the Fruit and Vegetable Conference.

Since it is not only desirable but necessary that there should be some co-ordination between the several agricultural producing units of the Empire and since so many of the Colonies have ensured agricultural development only with the aid of Imperial financial assistance, these visits from the Secretary of State's Adviser are of much value.—H.D.H.

DEPARTMENTAL NEWS.

Professor the Hon. J. S. Dash was absent from the Colony from September 22, to November 2, 1933, to represent British Guiana at the West Indian Inter-colonial Fruit and Vegetable Conference held in Jamaica.

Capt. F. Burnett, Deputy Director, was seconded from April 22 to September 6, 1932, to carry out, with the Commissioner of Lands and Mines, a joint survey of lands suitable for colonization and land settlement. The report which was a comprehensive one has since been laid before the Legislative Council and published as Sessional Paper No. 8 of 1933.

During Capt. Burnett's absence from the Colony on leave from September 6, 1932, to February 14, 1933, Mr. E. M. Peterkin, Agricultural Superintendent, East Demerara, acted as Deputy Director.

Mr. H. D. Huggins was granted nine months' leave of absence to pursue special post graduate studies in Agricultural Economics specialising in Marketing at Cornell University. Mr. Huggins was awarded a Carnegie Fellowship on the recommendation of the Secretary of State for the Colonies, and made a tour of the Eastern and Southern United States in order to study the agricultural economics work being done in those areas. Mr. Huggins also received his Master's degree from Cornell.

Mr. E. M. Peterkin visited British Honduras in May, 1933, at the request of the Government of that Colony to report on the possibilities of establishing a rice industry.

The British Guiana Rice Marketing Board was organised in December, 1932, and from its inception Mr. H. G. Seaford as President has given much valued time and service to the operation of the Board.

Mr. J. C. Gibson, a useful and valued member of the Sugar Experiment Stations Committee, planting attorney of Messrs. Booker Bros., McConnell & Co., Ltd., and manager of Pln. Port Mourant, became seriously ill during February, 1933, and left the Colony on furlough. We are pleased to report that Mr. Gibson is again in good health and has resumed his seat on the Committee and his work in connection with the sugar estates of the Colony.

Mr. C. H. B. Williams, Sugar Cane Agronomist, on the recommendation of the Sugar Experiment Stations Committee, was granted leave of absence in August, 1933, to undertake post graduate studies in Plant Breeding at Harvard University.

The following is the personnel of the Co-operative Credit Banks' Board appointed by His Excellency the Governor on September 8, 1933 :—

The Director of Agriculture (Chairman).
The Honourable E. F. Fredericks, LL. B.
The Honourable Jung Bahadur Singh.
The Reverend A. E. Dyett, and
Cyril Farnum, Esquire.

Mr. W. G. Delph, who was Secretary to the Co-operative Credit Banks Committee, was appointed Registrar of Banks on the same date. Consequent on the departure of Mr. Delph on leave from the Colony, Mr. A. A. Thorne, Accountant, Department of Agriculture, was appointed to act as Registrar, and Mr. C. A. Lashley, of the Treasury Department, was transferred to the Department of Agriculture to fulfil the duties of Accountant.

Mr. C. C. Dowding, Agricultural Instructor, was promoted from Grade 2 to Grade 1. Mr. D. D. Haynes, Assistant Instructor, was offered and has accepted the post of Resident Instructor, British Honduras.

The Department of Agriculture held one of its periodical Field Days at Sub-Station Pln. Cecilia, East Coast, Demerara, on Tuesday, April 3. There were a number of interested visitors, since the light soil type at this Station permits successful demonstration experiments with the vegetable crops most likely to prove suitable for cultivation in the Colony. On the following day some of the selected vegetables were displayed in the show window of one of the prominent groceries of the City and attracted much attention.

The Department has been very pleased once again to welcome the following visitors connected with the sugar industry of the Colony who have evinced interest in the work being done at the Experiment Stations and in other phases of the Department's work :—Sir Alfred Sherlock, Sir Edward Davson, Mr. C. A. Campbell, Mr. Ian Parker. Other welcome visitors included Sir James Currie, Chairman of Governors of the Imperial College of Tropical Agriculture, Sir Norman Lamont, prominent agriculturist and landed proprietor of Trinidad, and Sir. A. Gollan, late Attorney General of Trinidad.

JOHN EDGAR BECKETT, F.L.S.

The death of Captain Beckett, Agricultural Superintendent and acting District Commissioner, North West District, occurred at Georgetown, British Guiana, on February 24, 1934. While on tour in his district, he received an infection, which afterwards became septic, and was ill for nearly six months. Prior to this he always enjoyed vigorous health.

Born in British Guiana on July 1, 1878, he was educated at Queen's College and afterwards acted as Assistant Master at his old school for three years. He entered the Department of Science and Agriculture in 1900, was appointed Senior Agricultural Instructor to the Board of Agriculture in 1901, and resigned in 1908 to accept the post of Agricultural Adviser to Messrs. S. Davson & Co., in connection with their Rubber and Produce Plantation.

In 1924, he re-entered the Government Service as Superintendent, Industrial School, Onderneeming, and Immigration Agent for Essequibo, and, in 1925, was appointed Supervisor of the Government Land Settlement Scheme, Anna Regina. In 1926 he became Travelling Inspector to the Department of Science and Agriculture, in 1928—on the re-organization of the Department—Agricultural Superintendent, North West District, a post for which he was eminently fitted, and, in April 1933, was appointed to act as District Commissioner, North West District.

In 1905, he represented British Guiana at the West Indian Agricultural Conference held in Trinidad and visited Barbados in 1905-06 to report on the cotton Industry of that island in regard to the advisability of extending the industry in British Guiana. He was elected a Fellow of the Linnean Society, London, in 1919, and was a member of the Education Committee of 1925.

Captain Beckett wrote on many phases of British Guiana agriculture; among his chief publications are "*Hints on Agriculture*", published in 1905, and several contributions to *Timehri*, *the Commercial Review*, *the Journal of the Board of Agriculture* and the *Agricultural Journal of British Guiana.*

His loss is felt by the Department in particular and by the Colony in general; having lived and worked in almost every district of the Colony, there were few personalities better known to British Guiana agriculturists. It is with deep regret that the passing of this genial and hard-working officer is recorded.

J.S.D.

PLANT AND SEED INTRODUCTION*—JAN.-MARCH, 1934.

NAME	QUANTITY	WHENCE SUPPLIED
Black Eye Peas	5 tns.	Bureau of Plant Industry, V.S. Dept., of Agriculture, Washington.
Sweet Potatoes	50 bags (4,376 lbs.) 20 „ (3,636 lbs.)	Dept. of Agriculture Trinidad.
Ginger Canton Jamaica	52 lbs. 32 „	„
Pigeon Peas	2 lbs.	St. Augustine Nursery, Dept. of Agri., Trinidad.
Vegetable Seed	17 lbs.	Messrs. H. G. Hastings & Co., Atlanta, Georgia.
Vitex parviflora	1 packet	F. G. Walsingham, Harvard University, Ceinfuegos, Cuba.
Marsh Grapefruit	250 buds	St. Augustine Nursery, Dept. of Agri., Trinidad.
Foster „	250 buds	do.
Actinorhytis calapparia	2 plants	Coconut Grove Arboretum, Coconut Grove, Florida.
Areca sapida	do.	do.
Arenga mindorensis	do.	do.
Butia australis	do.	do.
„ *capitata X cripspathe*	do.	do.
Chamaedorea concolor	do.	do.
Chrysalidocarpus decipiens	do.	do.
Erythea edulis	do.	do.
Chamaerops humilis arborescens	do.	do.
„ „ *argentea*	do.	do.
„ „ *elegans*	do.	do.
„ „ *macrocarpa*	do.	do.
Gaussia princeps	do.	do.
Glaucothea armata	do.	do.
Macrozamia dennisonii	do.	do.
Ptychosperma sanderae	do.	do.
Roystonea floridana	do.	do.
Sabal yapa	do.	do.
Thrinax barbadensis	do.	do.
„ *radiata*	do.	do.
Trachycarpus excelsa	do.	do.
Washingtonia sonorae	do.	do.
Zamia pumila	do.	do.
Padi—51 Varieties	Small Quantities of each	F.M.S.; Assam; Bombay India; Tanganyika; Bengal; Cen. Provinces, India; Nagina; United Provinces, India.

***Important plant and seed introduction for 1932 and 1933 have been or are being published in the Administrative Reports.**

PLANT AND SEED INTRODUCTION—JAN.-MARCH 1934.
(*Continued*).

NAME	QUANTITY	WHENCE SUPPLIED
Richardia africana	2 plants	Royal Botanic Gardens, Trinidad.
Clerodendron ugandense	3 plants	do.
Hibiscus waimaea	1 plant	do.
Cuphea macropetala	do.	do.
Oncidium papilio	do.	do.
,, *luridum*	do.	do.
Epidendium Hartii	do.	do.
,, *rigidum*	do.	do.
Catasetum macropum	do.	do.
Acacia spp.	A quantity of seed	Botanic Gardens, Sydney
Eucalyptus spp.	do.	do.
Other Australian genera	do.	do.

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the agricultural and forest products of the Colony exported during 1933.

The corresponding figures for the same period during previous years and the average for the eleven years prior to that are added for convenience of comparison.

Product		*Average 1920-30*	*1931*	*1932*	*1933*
Sugar	tons	97,577	119,346	137,078	127,083
Rum	proof gallons	1,077,947	722,076	645,511	883,019
Molasses	gallons	1,509,631	7,106,997	7,554,520	8,137,233
Molascuit	tons	1,252	66	205	178
Rice	tons	9,386	23,632	28,541	29,120
Coconuts	No.	1,484,031	1,494,195	962,364	1,748,175
Coconut Oil	gallons	23,804	20,742	19,048	20,198
Copra	cwts.	26,195	27,617	15,131	18,421
Coffee	cwts.	5,467	7,102	9,415	10,207
Lime Juice Concentrated	gallons	8,455	8,347	958	None
Essential Oil of Limes	gallons	456	590	730	1,166
Rubber	cwts.	109	49	None	None
Balata	cwts.	8,335	6,834	5,699	4,282
Gums–Other kinds, lbs.		2,163	238	1,484	None
Firewood—Wallaba, etc.	tons	8,042	12,370	13,219	13,796
Charcoal	tons	2,475	3,220	3,770	3,268
Railway sleepers	No.	17,662	3,325	13,695	11,501
Shingles	No.	1,819,031	892,650	1,283,100	880,750
Lumber	ft.	183,613	246,426	142,429	163,083
Timber	cu. ft.	199,171	194,234	178,237	184,489
Cattle	Head	487	162	447	458
Hides	No.	7,529	2,973	4,987	5,110
Pigs	No.	460	425	431	413
Sheep	No.	31	16	27	2

***18 bags to ton**

CURRENT PRICES OF COLONIAL PRODUCE.

From The Commercial Review, Journal of the Georgetown Chamber of Commerce, Vol. XVII, No. 9, Saturday, 31st March, 1934.

SUGAR.

Per 100 lbs. net 3 lbs. per Bag allowed for tare

Dark Crystals for Local Consumption.. ....$3.30
Yellow Crystals do. do. $4.00
White Crystals..$4.75
Molasses Sugar..none offering

RUM.

Imperial Gallon. Cask included.

Coloured, in Puncheons—40 to 42 O.P...(for export)...50c. Hhds. 76c. Barrels 77c.
White, in Hogsheads—10 to 54 O.P...(for local consumption)...............45 to 55c.

MOLASSES.

Per Imperial Gallon. Cask (naked)

Yellow (firsts)..10c.
Yellow (seconds)..5½c.
Dark..2½c.

RICE.

Rice..............per Bag of 180 lbs. gross, Brown Super $3.75 to $4.00. White $2.75 to $3.50 as to quality. Lower Grades $2.25 to $2.75
Paddy . ...per Bag of 143 lbs. gross, 75c. to $1.00 as to quality. New Crop.

GENERAL.

Gold, Raw..average per oz. $23 to $24.
Diamonds,—*pro rata* as per quality..............................average, $10 per carat to $11.
Timber, Greenheart, (Lower grade measurements)...40c. to 60c. per c. ft.
for export 72c. to $1.00 per c. ft.
do. Railroad Sleepers—(Mora)..$1.68 each.
Greenheart Lumber...$60 to $70 per 1,000 feet.
Crabwood Lumber...$60 to $75 per 1,000 feet.
Shingles, Wallaba, 4 x 20 and 5 x 22 inches,...........................$3.50 to $5.50 per M.
Charcoal, Capped for shipment...72c. to 85c. per bag.
Firewood...$2.16 to $2.50 per ton.
Coconuts...Selects, $9.00, culls...$6.00 per M...Copra $1.50 per 100 lbs. prime Copra.
Balata................................Venezuelan, none. Local Sheet...36 to 38 cts. per lb.
Cocoa..14 cts. „ „
Coffee...7c. to 8 cts. „ „

N.B,—Duty on Payable value at time of Importation and rate of exchange on day of arrival.

METEOROLOGICAL DATA, 1933.

BOTANIC GARDENS, GEORGETOWN.

1933 MONTHS.	Rainfall, Inches	Number of Days of Rain: Under .10 in.	.10 to .50 in.	.50 to 1.00 in.	1.00 to 2.00 in.	Above 2.00 in.	Total Days	Evaporation Inches
January	7.24	6	12	2	3	...	23	4.18
February	4.66	5	10	1	1	...	17	4.58
March	6.10	3	11	1	...	1	16	5.21
April	5.60	5	4	2	...	1	12	5.24
May	14.34	7	12	6	1	1	27	4.25
June	12.56	6	11	4	2	1	24	4.01
July	8.16	7	8	4	1	1	21	4.45
August	14.45	5	8	4	2	2	21	4.45
September	1.82	4	3	1	...	...	8	5.80
October	4.12	5	3	1	2	...	11	5.15
November	10.40	6	7	2	3	1	19	3.29
December	27.10	6	3	5	9	3	26	2.44
TOTALS	116.55	65	92	33	24	11	225	53.05

AIR TEMPERATURE AND HUMIDITY IN THE SHADE, BOTANIC GARDENS, GEORGETOWN, 1933.

MONTHS	Air Temperature: Maximum	Minimum	Mean	Humidity: Mean
January	84.2	75.2	79.7	81.9
February	83.6	74.9	79.2	77.3
March	84.3	75.3	79.8	79.3
April	85.1	76.1	80.6	79.3
May	85.1	76.6	80.8	83.5
June	85.4	75.3	80.3	84.3
July	86.5	74.9	80.7	83.0
August	86.2	75.6	80.9	83.4
September	87.7	76.2	81.9	79.4
October	87.8	75.8	81.8	80.2
November	85.7	75.6	80.6	83.5
December	83.4	73.9	78.6	86.3
Mean	85.4	75.4	80.4	81.8

WETTEST AND HOTTEST DAYS AT VARIOUS STATIONS.

Stations	Wettest Day	Rainfall, Inches	Hottest Day	Temperature in shade
Botanic Gardens, Georgetown	15th May	6.25	20th Sept.	89.5
New Amsterdam, Public Gardens	25th Dec.	6.45	10th, 12th, 15th, 20th December	99.0
Onderneeming, Essequibo	30th Oct.	2.49	2nd & 3rd July	92.0
Hosororo, N.W.D.	25th Jan.	2.83	9th & 11th October	93.5

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In collaboration with the Officers of the Department of Agriculture.

CONTENTS.

(VOL. V, NO. 2.)

ORIGINAL ARTICLES.

The
Agricultural Journal of British Guiana.
June, 1934.

EDITORIAL.

PLANTAINS.

"*The considerations which govern the establishment and growth of an* "*industry are, or should be, purely economic, and any departure from this stand-* "*point is bound to be attended sooner or later with financial disaster.*" Thus runs a passage in the editorial of "*Nature*", March 24, 1934.

If we accept this view, the inference is that, in this and other countries, a popular method of approach to agricultural development is frequently made from a wrong starting-point. A typical order of events is that a person living in one country, say A, discovers that persons living in another country, say B, are finding the cultivation of a certain crop profitable; the success of the crop in country B is adduced as sufficient reason for the establishment of the crop in country A. The deduction is unsound, since, as "*Nature*" has reminded us, the considerations which govern the establishment and growth of an industry must be purely economic.

It is easier to turn from one crop to another than to alter the economic conditions of a country. It is, therefore, a safer course to examine dispassionately the conditions operating in a country, basing policy on the knowledge gained by observation and experiment, and to give prior attention to those crops which appear to be adapted to the prevailing environmental and economic conditions.

During recent months, the consideration of certain new crops has, to a large extent, monopolised discussions of our agricultural development If, however, the line of approach recommended above is followed, it might serve a useful purpose to revert popular attention to those industries which experience has indicated are suited to the country's conditions.

Sugar and rice are eminently suited to large areas of our agricultural land and the progress of these crops, as judged by purely statistical standards, is proof of this. Coconuts have proved successful on the light soils in many districts; the consumption of more coconut products on the local market consequent on the manufacture of high grade edible oil in the Colony and the protection by

Government from external competition has improved the outlook for the industry. Coffee is the outstanding crop of the pegasse areas and the industry gives indication of extension, the 1932 export figures being higher than in any previous year and the 1933 exports being even higher than those in 1932.

Among the minor crops, plantains are probably the most important. The crop thrives best on a loamy, friable soil with a low water table. Those who are acquainted with the peasant cultivations in different parts of the Colony are aware that there is no other crop more universally cultivated.

As a vegetable, it enters to a considerable extent into the diet of the people of the Colony and there is in consequence a consistent local demand. Most of the plantains consumed in Barbados are imported, and, in Trinidad, production does not meet demand. Hence, there is an export as well as a local market for British Guiana plantains, and the figures below show the exports during the last four years :—

1930	...	76,103	bunches
1931	...	42,797	"
1932	...	65,186	"
1933	...	35,583	"

Plantains are shipped in bunches to Barbados direct by schooner since the freight is low and the time taken by schooners from British Guiana to Barbados compares, favourably with, and in many cases is better than, the time by steamers. The freight to Barbados by schooner is five cents per bunch.

In the case of plantains for export to Trinidad, the bunches are stripped and the fruit packed in tierces, one tierce being estimated to hold about 10 bunches. The freight, wharfage charges, etc. amount approximately to $1.15 per tierce or 11 cents per bunch. The trade with Trinidad is largely by steamer, as schooners leaving this Colony for Trinidad are generally loaded with empty gasolene drums and additional freight sought is of a heavier type suitable for ballast.

The question of freight has been discussed in some detail since those associated with the export plantain trade claim that a limiting factor to increased trade with Trinidad is the high freight rates. The freight on plantains is a question for consideration since the main competitor for the Trinidad market is Venezuela, and the latter, being nearer to Trinidad, ships by sloop and consequently at lower freight rates.

Enquiries recently made in the trade have shown that the price for plantains during the main season, or, when the bulk of the crop is available, delivered in Georgetown for export, is about 24 cents per bunch; at other times, during the off-season, as much as 40 cents per bunch can be obtained. These prices compare most favourably with the published prices offered in Trinidad for bananas by the United Fruit Company. That Company has offered to buy in Trinidad all ex-

portable bananas at 50 cents per bunch of 9 hands, 36 cents per bunch of 8 hands and 25 cents per bunch of 7 hands, delivered in Port-of-Spain.

From recent investigations in different parts of this Colony it is clearly indicated that the average banana bunch of the ratoon crops, is 7 hands or less and seldom 8 hands or more. The careful handling called for by bananas is not demanded by plantains and hence the cost of internal transport is likely to be higher for the former than for the latter. In the plantains trade there is no question of 'rejects', while in the export banana trade no bunch of less than 7 hands is marketable, and bananas cannot be exported in tierces as plantains are for Trinidad at the present time.

In plantains, the Colony has a crop which offers as high a monetary return as any of the new crops which have recently attracted so much local attention.

OBSERVATIONS ON A JOURNEY FROM THE MOUTH OF THE AMAZON TO MT. RORAIMA AND DOWN THE CATTLE-TRAIL TO GEORGETOWN.

BY

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INTRODUCTION.

The journey, on which the following notes were made, was undertaken in the course of investigations on the possibility of biological control for pests of West Indian and Guiana agriculture, under the auspices of the Imperial Institute of Entomology, the Empire Marketing Board and the Trinidad Sugar-cane Investigation Committee.

In several publications the writer has emphasised the desirability of basing such researches on sound ecological data, especially with a view to ascertaining whether the control of a pest insect in a given locality is due to natural enemies and not to local conditions of climate, soil, vegetation, history or agricultural practice. The present report, however, consists less of exact data accumulated for their bearing on the main problems of the investigation, as of miscellaneous impressions of a travelling agricultural ecologist. His Excellency the Governor of British Guiana expressed the opinion that these were of general interest, at least to that Colony, hence their present compilation.

The writer and his assistant entomologist, Mr. Desmond Vesey-Fitzgerald, arrived by aeroplane in Pará soon after the middle of June, 1932. After some time in the surrounding countryside they visited the ranching areas of the island of Marajó and then ascended the Amazon in a small and filthy Brazilian steamer, which stopped at all settlements and took on firewood between ports. They stopped at Santarem, then ascended the Rio Tapajos to Fordlandia, where they inspected the Ford rubber estates. Returning to the Amazon they continued upstream to Manáos, followed the Rio Negro and Rio Branco up to Boa Vista and thence ascended the Takutu to the Rupununi savannahs of British Guiana. From these savannahs they took the forest route up the left bank of the Ireng to its head and to Mazaruni Head and thence eventually to Mt. Roraima, returning *via* the Venezuelan and Brazilian savannahs to Viçosa on a stream flowing into the Rio Uraricuera. Reaching thus Boa Vista again, they found low water made communications with Manáos uncertain and lengthy; so they returned to the Rupununi and walked down the cattle-trail to the coast, arriving in Georgetown towards the end of January.

Since this article was written the journey from Georgetown to Pará has been made a second time, on this occasion by the Essequibo River, and although the main object was the introduction of the Amazon fly into British Guiana, the opportunity was taken to make further general observations.

Considering the West Indies and Guiana as a whole, the pests attacking sugar-cane are the most important, and most of them were originally attached to wild grasses. On this account special attention was paid to wild grasses and to grass-lands of every kind, from the lowland swamps to the high savannahs of Roraima. A comparative account of these natural grass-associations will be published shortly in a botanical journal, to supplement the writer's comparative notes, already printed, on the Venezuelan llanos. Only data of more immediate economic interest will be repeated here.

BELEM DO PARÁ.

This city of some 200,000 inhabitants, near the Amazon mouth, is usually called "Pará" by foreigners and "Belém" by Brazilians. The chief factor in its growth and prosperity was the rise of the wild rubber industry. Pará is still simply a port, with surprisingly little cultivation in the surrounding country, and with a commensurately great dependence upon imports to supply most of its needs. Such cultivation as we saw on one of the few country roads, that of Vigía, was largely of the peasant type, consisting of mere temporary clearings either in virgin forest or in tall second-growth woods. Considerable areas were abandoned to low scrubby second-growth bush. The scrappy crops were chiefly sugar-cane, cassava and upland rice.

In order to see more extensive cultivations, especially of sugar-cane, several of the adjacent rivers and creeks were traversed for a few days by launch. Igarapé-mirim, recommended as the centre of an important sugar district, was visited and found to consist of a little more than a narrow muddy water-front, exceedingly insanitary, dominated by a church of the usual Portuguese style. Below the settlement, on the creek banks, was a succession of tiny ramshackle mills, mostly manufacturing crude cane-spirit—cashaça—the drink of the country. The canes were brought in small dug-out canoes from tiny and widely-separated cane-patches growing on the low mudbanks at the water's edge, in many cases with mukka-mukka (*Montrichardia*) growing between the stools. The cane, which was planted in no regular rows, was almost entirely of one soft white or pale green variety known locally as "canna branca", not distinguishable from that grown in the Orinoco Delta by the aboriginal Indians. Infestation by a small moth-borer (*Diatraea*) was at the rate of about seventeen per cent. Behind these mudbanks virgin forest reigned untouched.

In the same district, on the Rio Panacuera-assú, was eventually a factory (*usina*) of a larger and better type—that of Senhor Avellino J. doValle. This mill was grinding two varieties of cane—*canna rosa* or "Cavengie" and *canna branca* or "Cuba", but the latter was vastly in the majority, and is preferred. A field

supplying the mill extended along some 300 metres of half inundated river-front and stretched inland one kilometre to the virgin forest. This was considered a very unusual width. Cane is planted when it is cut, the tops being stuck at random into the mud. This is done twice to four times according to the "quality" of the land which is then abandoned to bush, and another strip of riparian forest is felled and burned. Only virgin forest land is taken in.

This factory produced per year, chiefly for consumption in Pará, 1,440,000 kilograms of white, very finely granulated sugar, ready for consumption, 7,320,000 litres of cashaça and 3,660,000 litres of fuel alcohol.

More extensive cultivations of every kind occur on a number of Japanese holdings at a greater distance from Pará. The agricultural expert in charge was, however, absent at the time; so arrangements were made to visit them on our return journey from the Rio Negro; but instead we returned to the coast at Georgetown.

Island of Marajó.

This huge island at the mouth of the Amazon was visited to investigate the savannahs of its eastern and south-eastern portions—the centre of the largest ranching industry in Amazonia, much more important than that on the upper Rio Branco. For the statistics relating to the industry I am indebted chiefly to Le Cointe. The area of these savannahs (or *campos* as they are called throughout Brazil) is about 15,000 square kilometres. But in the wet season this is very considerably reduced by inundations. It was very interesting to find that the vegetation is of a type intermediate in some respects between that of the coastal savannahs of British Guiana and that of the Rupununi (and Rio Branco). The Marajó savannahs are divided according to elevation and drainage into two main types—lower (*baixo*) and higher (*alto*)—the former being largely under water for as much as half the year. On the first the vegetation consists chiefly of *Panicum laxum* (a grass which has only a restricted distribution on the Rio Branco savannahs) and miscellaneous sedges. The higher savannahs are covered almost entirely with *Trachypogon plumosus*, the common savannah grass of the Rupununi.

The fazenda visited consisted of some 150 square kilometres—open savannah of both types dotted with islets of forest. It carried 800 horses and 6000 head of cattle, predominantly zebu, of which good blood had been imported at considerable expense direct from India. The proprietor, who owned also several other large fazendas, was a veterinarian from Switzerland. It was interesting to observe that while his professional training led hin to treat cases of sickness with considerable care, it had to no appreciable extent, modified on his ranch, the traditional Brazilian methods of handling stock and managing horses, which are precisely those employed in the Rio Branco and Rupununi (wherever Brazilian vaqueiros are employed) and which seem to a Northerner so unnecessarily brutal. Here we

saw first the jagged iron nose-band which is employed instead of (or sometimes in addition to) a bit, and which saws deep and unsightly scars on the faces of all the riding horses.

We returned down-river to the coast of Marajó in a small steam-tug which brought two large schooners loaded with cattle from Pará—a journey of some twelve hours from this particular ranch. The loading was observed. The frightened cattle were hustled by excited blacks down a narrow race to the water's edge. There a noose was fastened round their horns and they were slung bodily into the belly of the ship, to dance for a time on their hind-legs till they were rushed by two men, seized by the legs, tail twisted under thigh and thrown, to be presently tied by the head to the ribs of the ship. Should one lie down it was immediately trampled on by its fellows. If repeated tail-twisting with a long forked stick did not prevail on it to stand up, the winch was brought to bear again and the injured beast slung up, by horns, neck or whatever was most convenient and dropped into the water. Some managed to swim ashore, others sank.

The Marajó ranching industry was established in 1692. By 1803 there were 226 fazendas, with altogether half a million head of cattle. Horses meanwhile increased even more rapidly, till in 1820 there were said to be a million roaming half-wild over the savannahs and constituting a serious pest to the cattle-owners. These horses were killed on a large scale for their hides and the carcases left to rot. This practice was followed by and blamed (not on very obvious grounds) for an epizootic of *mal de caderas* which then broke out and spread throughout the Amazon to the upper Rio Branco. The horses of Marajó were almost exterminated and bullocks were used for riding-animals—a practice which has survived there to the present day. Disease and heavy floods diminished catastrophically the cattle also, and in 1880 the island counted less than 200,000 cattle and 8,000 horses.

The average weight of cattle (on the hoof) entering the market at Pará (chiefly from Marajó Island) is estimated by Le Cointe at 220 to 270 kilograms.

The Lower Amazon Generally.

The nearly 1000 miles to Manàos were covered in small steamers with the maximum number of halts and usually only an hour of so each, barely sufficient for a brief examination of the cane, grasses or cocoa growing in the vicinity. Longer stops were made to load firewood, but this took place more often at night. We were rarely in the main channel, but followed "*paranás*" or parallel passages, which were sufficiently narrow to keep us in sight of land practically the whole time. Again one received the impression that the extent of cultivation is comparatively negligible—unbroken forest for miles, by no means monotonous, but of very varied types. There were occasional small timber mills, cane-fields, cacao plantations; but in every case the forest at the back showed that the fringe of human influence was very narrow.

The sugar-cane, of the same varieties as those seen near Pará, showed practically no economic damage from insect pests. Cacao both near Pará, and on the main Amazon almost to Manáos itself, was heavily attacked with witch-broom disease—apparently not heretofore recorded from Amazonia.

The settlements, even those established 300-400 years ago, were mostly little more than villages; in some cases they had decreased very greatly in recent years from malaria and economic causes, chiefly consequent on the slump in rubber prices.

During the greater portion of the journey, a striking feature was the floating grass (chiefly *Paspalum repens* and *Echinochloa polystachya*) forming huge beds for long distances and for a great width along the banks—even more extensive than those previously studied on the lower Orinoco. It would be difficult to estimate the area of these floating grass-beds, since they are not continuous either on the main river or its affluents, but the total area in Amazonia must certainly be much greater than the acreage in sugar-cane in all South America. Here is one of the original homes of the small moth-borer (*Diatraea*), which is estimated to take annually about 20 per cent. of the British Guiana sugar crop. The grass beds consist very largely of the above two species, one of which (*Paspalum repens*) occurs plentifully in the plantation trenches in British Guiana, while the other is represented by fewer numbers. It was in these grasses that the new Amazon Fly Parasite (*Metagonistylum minense*) of the borer was discovered near Santarem, on the main river. This efficient parasite has now been introduced into Guiana, and is established on several plantations in Demerara and Berbice.

Japanese colonisation is taking place in a quite and undemonstrative manner, but on quite a considerable scale, in both States of the Amazon basin—Amazonas and Pará. Our projected visit to one of their chief holdings was postponed and in consequence the little information that can be given here is almost entirely second-hand. They are growing sugar-cane, cacao, rice and guaraná on a large scale and are experimenting with a large number of other tropical crops, at a number of stations scattered about Amazonia. Guaraná is a vine (*Paullinia cupana* or *P. sorbilis*) which grows wild between the River Tapajoz and Madeira. The fruit grows in bunches like grapes. The seeds are roasted, ground and made into cakes which are later used to prepare the drink, guaraná, which may fairly be called the national drink of Amazonia. Le Cointe lists a formidable number of valuable medical properties, due chiefly to the high content of cafeine. Guaraná is said to contain 5.07 per cent. of cafeine, as compared with 1 per cent. in coffee, 1.20 in maté and 2.13 tea (*Stenhouse*). It is met with usually in the form of an aerated bottled drink, of a very attractive flavour, which seems to grow on one. It is said that the Brazilian authorities have forbidden the export of seeds or parts of the plant.

As an example of the thoroughness with which the Japanese are undertaking colonisation in Amazonia it may be mentioned that a young Japanese graduate with high honours in agriculture had been posted to a position as a junior waiter in our hotel in Manáos in order that he might become thoroughly fluent in Portuguese, He improved the occasion to practise English with us.

FORDLANDIA.

The Rio Tapajoz, a large affluent of the right bank of the Amazon, was ascended some 120 miles to Boa Vista or Fordlandia, the settlement on the Ford rubber concession, permission to visit which had been obtained from the General Manager in Pará.

The concession, not yet properly surveyed, consists of approximately 4,000 square miles, still mostly under virgin forest with a considerable quantity of wild rubber (*Hevea brasiliensis*). The settlement was begun only five years ago, and the first year was practically wasted, the labour difficulties proving almost insuperable and the first manager unsuitable. 4,500 acres are now cleared of forest and planted in thriving rubber trees. This does not include the nurseries, which contain two and a half million seedlings. A leaf disease has been troublesome in some of the nurseries, but insect pests have given little trouble. Locusts are periodically a nuisance and locally leaf-cutting (coushie) ants defoliate a few trees. They are controlled by blowing Cyanogas into the nests. Occasionally two or even three applications are necessary.

The management was at first advised, by planters from the East, that shade would be necessary for the young plants. They thought also to plant something which would bring in revenue while the young rubber was growing. They therefore planted pigeon-peas, but found that the rubber in the shade of these bushes was spindling and retarded compared with that in the open. It was therefore decided to dispense entirely with shade and to give up also the hope of a catch-crop. The notion of planting *Calopogonium* as a cover crop, to lessen the cost of weeding, was derived from Eastern practice. It succeeded beyond all hopes, and at present the whole area, save for a small circle round each tree, is covered with a dense, thick blanket of this legume.

Clearing of the forest was accomplished in the beginning by directly employed Brazilian labour, paid not by results but by time, a commodity not usually regarded as valuable in Brazil. This method proved altogether too expensive, and at present all clearing is done by contracts let to American and Brazilian Concessionaires. At the time of our first visit (1932) the company was buying all the lumber from these contractors, delivered at rail head by caterpillar tractors lent by the company. The logs were carried to the settlement by the Company's railways and used for fuel and for timber. They were handled by the largest and most up-to-date saw-mill in South America. Great logs, four feet in diameter, were rolled off a railside pile, grappled into a conveyor, subjected to a furious stream of water to remove grit which might injure the saws, raised to the second floor of the mill, and thrown bodily but with careful adjustment, into the shrieking path of a great bandsaw, which cut them, with astonishing speed, into large thick planks. These passed through a succession of other saws, all operated by

previously untrained Brazilians, which finally reduced them to usable and standard. sizes. The capacity of the mill was 25,000 board feet (1 sq. ft., 1 in. thick) per 8-hour day. There was provision, if necessary, for two shifts, to run 16 hours.

The kind of timber received at the mill varied with the area from which forest was being cleared. For the first six months of 1932 the chief timbers handled were as follows :—

Andiroba (*Carapa Guyanensis*) ... ... (This is indentical with Demerara "crabwood").	12.44 per cent.
Para-para (*Jacaranda copaia*)	11.08 „ „
Castanheira (*Bertholletia excelsa*) ... ... (This is the wood of the Brazil nut tree).	10.52 „ „
Muiracoatiara (*Astronium Lecointei*)	8.29 „ „
Cedro (*Cedrela odorata*) (They have probably misdetermined this botanically ... It is more likely *C. mexicana*).	7.42 „ „
Marupa (*Simaruba amara*).	7.35 „ „
Massaranduba (*Mimusops Huberi*) ... ... (This is the common Amazonian representative of British Guiana balata).	7.06 „ „
Cumarú (*Dipteryx odorata*) (-Tonka bean) ...	2.63 „ „
Guariuba (not yet identified)	2.53 „ „

And many others in small quantites, making a total of 86 distinct species of timber trees received at the mill. In addition all those which had proved susceptible to borer of any kind were left in the forest to be burned or used as fuel in the settlement (the power house burns only wood).

Some of the timbers were seasoned in the open or under tarpaulins. Others went to the great kilns, the only ones in South America, where individual treatment, arrived at by considerable experimental work, was given to each. These kilns had a capacity of 100,000 to 125,000 board feet. Heat and humidity were very ridgdily controlled and recorded by elaborate instruments with dials arranged along a tunnel corridor beneath the whole series of kilns. 165,000 board feet of timber, cut to standard sizes, had up to that time been exported (in one experimental cargo) to find a market for the newer and less familar kinds in the north. The bulk of the output was, however, so far used in the building of the model settlement. On my second visit in 1933—a year later—I found lumbering operations had ceased, and the great mill closed down. The trial shipment had not travelled well, the timber had arrived in poor condition, and this combined with another factor—namely, the increasing distance of the clearings from headquarters, rendering the railway more and more expensive—had led to the aband~~me~~nt of the whole timber enterprise.

This is an ultra-modern town set in the midst of the wilderness, and is the feature of the enterprise which has seized most of the Brazilian imagination. Thus, the only published account which seems to be available is sub-titled (in Portuguese) "Description of the marvellous city which Henry Ford is building in the interior of the State of Pará."

The dwellings are all of a model type, all closely mosquito-screened. The community was using 300,000 gallons of water per day. This is pumped up from the River Tapajoz,—a clear water, with practically no settlement above Fordlandia—is treated with a solution of salts to coagulate all impurities, then filtered through a series of sand-beds, treated with chlorine and finally pumped to a high tank for distribution. To avoid the need for two pipe-systems, all the water, including that for the labourers' shower-baths is thus sterilised.

The chemical laboratory, with three highly qualified organic chemists, is, apart from testing rubber, also investigating a large range of local fibres and oils. A machine had been elaborated for pressing out the very attractively-tasting oil (solid at ordinary temperatures) of a palm (*Astrocaryum tucumá*). Among paper-making plants some had shown themselves promising, but none could be got in commercial quantities.

Restaurants and every kind of shop have been built by the Company and let out to concessionaires. The Company maintains an excellent school.

The hospital, in the charge of young northern doctors, is extremely modern, spacious and well-equipped.

Much of the food of the community is grown locally. A cattle ranch has been established, the cleared forest being planted with Wynne grass (*Melinis minutiflora*), and let to a contractor. The fruit farm is, however, still administered directly by the Company. It consists of some 66 acres, under a great variety of fruit trees, some, especially most of the citrus kinds, badly attacked by insect-pests, undoubtedly introduced into this virgin area with the original plants a few years ago. A little biological advice—which seems to have been entirely absent from this purely biological experiment from the beginning—would have avoided completely this troublesome infestation, which can now only be endured, at least palliated by an expensive spraying programme. To digress slightly, it was most striking, in contrast, to see the thriving citrus plantation of Mr. B. L. Hart, in the Rupununi District of British Guiana, as far as I could see, entirely free from the common citrus pests—this not because he had been any wiser in seeking biological advice but because, owing presumably to transport difficulties, he had established this plantation entirely from seeds, and these do not carry scale-insects.

The difficulties of settlement at Fordlandia were greatly augmented by the hilly terrain. Here a low tongue of the great Brazilian plateau pushes northward between the River Tapajoz and Xingú. In spite of this some 30 miles of road, on which it is possible to drive a car, have been laid down, and steam-shovels were at work removing bodily hills which were causing too much detour.

The personnel consists of 94 per cent. of Brazilians. The higher employees are of very varied nationality. The wages and salary bill was in the region of £10,000 per month. The personnel and the scale of operations, however, were a year later greatly reduced.

MANAOS.

Manáos, on the Rio Negro a little above its junction with the Amazon, has a population of some 60,000. The huge Opera House, now scarcely used for years, its tremendous dome painted with the national colours of green, yellow, blue and chesnut, dominates the town, but the visitor sees first the large market, on the roof of which some 94 black vultures supplied an unfavourable commentary on the sanitary conditions. The main streets and residential quarters are, however, kept remarkably clean. Squalid conditions consequent on the depression following the slump in wild rubber (due to Eastern plantation competition), on which commodity the prosperity of Manáos almost solely depended, are in striking contrast to the magnificence of boulevards and buildings which remain as monuments of departed grandeur.

BOA VISTA DO RIO BRANCO.

From Manáos we were able to take a small river steamer 500 miles up the Rio Negro and Rio Branco to Boa Vista, where one finally leaves the great equatorial forest and enters extensive savannah country which has come into being in response to climatic factors namely, a lesser rainfall and a much more closely restricted wet season with a correspondingly long and almost rainless dry season.

The lower reaches of the Rio Branco, up to and including the first rapids, although rich country, abounding in game and gigantic fish, are almost depopulated by malignant malaria. Towns said to have had a population of several thousands have in several cases completely disappeared, and the sites of formally extensive plantations are now marked only by tall second growth forest. The Hamilton Rice-Harvard Medical Expedition (1924-25) remarked on "the great prevalence of disease among the few inhabitants who remain, and the entire absence in these regions of anyone in robust health."

Boa Vista, with a population of about 1,600 is situated well beyond this region and within the incomparably more healthy savannah country. It formerly maintained a factory or two and a hotel, but these no longer exist. There is no doctor nearer than Manáos—or by a more difficult route, Georgetown; but the Benedictine Fathers and Sisters maintain an infirmary.

Boa Vista is the distributing centre for the cattle industry of the Rio Branco. Manáos is the chief market, though some of the Rio Branco cattle eventually reach Pará. There is a trail by which the cattle, collected together at Boa Vista, are driven some 80 miles, to below the main rapids at Cara-cara-y. There one is still on the edge of the savannahs, and the cattle are enabled to feed and rest before being loaded on large barges (*batelões*), which are towed by steam-launches, travelling

day and night, the remaining 400 odd miles to Manáos, where they arrived two or three days after leaving the savannahs. The Brazilian ranchers are thus much less troubled by the transport problem than our ranchers of the Rupununi, but the industry is nevertheless exceedingly depressed owing to the failure of the wild rubber industry centred in Manáos. At the time of our first visit the best beef was selling in Manáos at one milreis (about 5½d.) per kilogram retail.

THE RUPUNUNI SAVANNAHS.

By far the predominant grass over the whole of the Rupununi savannahs, both north and south of the Kanuku mountains, is *Trachypogon plumosus* (Macusi name. Wan-na). The distribution of other grasses and other savannah plants was studied in some detail. Three questions are of special interest to the ecologist and may be considered briefly here.

The first is that of stocking. As Major Bone has already remarked, the whole area is greatly understocked. One may ride for days and see practically no sign of grazing save in the immediate vicinity of corrals and homesteads. This is in marked contrast to the savannahs just across the border in Brazil and the still more extensive llanos of Venezuela, especially in the States of Guárico and Apure. Both the Brazilian and the Venezuelan plains have been stocked for a much longer period than the Rupununi. Save within ten miles or so of the main affluents of the Orinoco they began with a closely similar vegetation which has now been very profoundly modified over huge areas, especially in Venezuela. This modification which is wholly in the direction of deterioration, is probably due less to gross over-stocking than to mismanagement leading to overstocking for certain periods and in certain areas. There are now, especially in Venezuela, hundreds of square miles covered almost exclusively with inedible weeds, notably *Hyptis suaveolens* in the drier plains and *Ipomoea crassicaulis* in the hollows. In the Brazilian campos of the Rio Branco there are similar though less extensive areas of *Sida* sp., a weed which, among others, also takes possession in the Rupununi, but so far, only in small holding-paddocks and corrals, which are necessarily periodically overstocked. The Rupununi savannahs as a whole are as yet unspoiled ; the vast bulk of their vegetation consisting of a grass which, while not eminently palatable in its older stages on account of coarseness and toughness, is yet eaten regularly by cattle and must form one of their mainstays. The older settled savannahs of Brazil and Venezuela, however, undoubtedly indicate the changes which may be expected if stocking is increased in the Rupununi anywhere near to capacity without the provision of fences or other means for the correct management and rotation of pastures.

The second question is the much disputed one of burning the savannah. This was an old and traditional custom of the Indians for signalling and other purposes long before European stock was introduced, and has become a regular practice on both Brazilian and Rupununi ranches, with or without the consent and encouragement of the owner or manager. It is a matter of common observation that cattle

concentrate from considerable distances on areas which have recently been burned, and graze eagerly on the fresh green growth. So far as one can gather from ecological study, this burning is not modifying and *at least under present conditions of stocking* cannot modify the composition of the savannah vegetation (which is what Clements calls a fire sub-climix)—the elements of which have been accustomed and adapted, to periodic burning over a very long period of time. There would probably, under present low stocking, be more scrub and less grass if burning were not practised. It seems therefore unlikely, present conditions of stocking being always understood, that burning is doing any damage in the Rupununi, provided it is done early enough in the season to ensure that there will be sufficient rain coming to prevent the resultant young growth from dying. And at present, without the use of fire, there is not enough grazing to prevent an undesirable accumulation of coarse roughage, to the production of which the dominant grass, *Trachypogon* particularly tends. There are no entomological grounds for the belief expressed to me more than once that burning destroys natural enemies of ticks and so increases the ear-tick infestation. Burning must probably destroy large numbers of larval ticks and must thus, as far as it affects the tick problem at all, be considered beneficial.

As Hensel (*Jl. Agric. Res., Vol. 23, pp. 631-643, 1923*) remarked, after extensive and well-controlled experiments on Kansas grasslands, "The last word regarding burning has yet to be written. The results secured, as these experiments show, will likely depend not only on seasonal conditions but also upon the kind of grasses and other vegetation present,"--The results in question showed (1) that in the earlier part of the season, there was considerably more growth of grass on the burned areas; (2) after four years there were 21 per cent. more grass plants on the burned areas than when the experiments began, while the unburned areas showed an increase of only 7 per cent.; (3) there was a decrease of sedges on the burned areas, and an increase on the unburned; and (4) weeds decrease on the burned areas and increased on the unburned. "The conclusion is that studies so far conducted have failed to show that burning is injurious." (Hensel). These remarks apply, of course, solely to the light burning of grassland. Forest fires, on the other hand, are of course always and everywhere injurious, but these are rarely deliberate, save in the tiny patches of Indian provision-ground, where the fire is well under control, and is restricted to the felled or partially felled area.

The third question is, what do the cattle atcually eat. The application of the direct method in ecology, so successfully used by Dr. Leonard Cockayne in studying the montane tussock grasslands of New Zealand, is valuable here, and was employed by the writer, using as subjects the five pack-bullocks which brought his baggage to the coast. The result of this study will be published in detail, but it may be interesting to remark here that several savannah plants not commonly regarded as pasturage at all are evidently greedily eaten by stock. These include the dwarf shrubs (*Byrsonima verbascifolia* (Macusi name, *kenamanarare*), *Byrsonima crassifolia* (*maripati*), and *Palicourea rigida*. The last is specially interesting

since Le Cointe, writing of Amazonian pastures. mentions a *Palicourea* among the list of plants poisonous to stock. Chemical investigations would be desirable, but the animals seem to suffer no ill-effects.

The Rupununi savannahs form a biological island, separated in every direction from civilisation by vast forests, formerly only traversed by rivers, offering little chance of passage to introduced insect pests. As a direct result, the cultivated plants of the Rupununi are usually free from pests other than those, little serious, which are already indigenous to the hinterland*. The cattle-trail has pierced this barrier in a small way, and additional traffic from the coast will provide opportunities for pests to reach the Rupununi. It would be eminently desirable to delay this ingress of pests as long as possible, if, as seems probable, it may not be practicable to stop it altogether. Ranchers bringing plants of any kind from the coast would be well-advised to fumigate or spray them before leaving; or else bring only seeds.

Rupununi to Roraima.

In the Rupununi during the month of September it was exceedingly difficult to procure Indians as carriers owing chiefly to the prevalence of severe fevers in many of the settlements. When we finally set out, up the left bank of the Ireng, towards Roraima, the first large village, Kurasabai, some ten miles within the Pakaraima mountains, had just one-third of its total population down with fever, and there had been several deaths. In addition this village, formerly noted for its horses, had recently lost everyone of them, apparently from *mal de caderas*. Beyond Kurasabai, right through the Pakaraimas, to Mazaruni Head and Roraima, we met no more fever among the Indians, save an outbreak among my own men undoubtedly already infected. There were no more requests for quinine until we had left Roraima and were well down in the savannahs again on the Brazilian side.

The route lay very largely through forest—but forests of very varied types—some of the variation being due to widely different original botanical composition and others to extensive burning, resulting in different stages of second-growth succession. Much of the forest in the mountains just north of the Rupununi savannahs might almost be classified as monsoon-forest, with an abundance of such trees as *Ormosia histiophylla*, *Cochlospermum* and *Helicteres*. A considerable proportion of the trees in such woods are completely leafless during the dry season. But even when, further north, one traverses almost continuous high tropical rain-forest, different types succeed one another several times in the course of every day's march. In addition to typical mixed rain-forest, there were no fewer than four kinds in which dominance of one species was so nearly absolute that these woods consisted of almost pure stands over considerable areas. Unfortunately the problem of identification is almost insuperable to a traveller

*Karinambo already forms an unfortunate exception to this, in that citrus plants there are seriously plagued with scale-insects, attened by ants.

especially as the trees in question were often quite unknown to my Macusis. Among these pure types was mora, which grows in this region in practically pure stands, as in Trinidad, and far more so than in the British Guiana lowlands. In one such stand I measured a fallen mora 152 feet long to where the main branches still seven inches thick had rotted and fallen away. This tree must have been 200 feet high. Another gregarious tree, occupying smaller areas, however, was a species of *Peltogyne* (purpleheart). A third was a lofty tree with tremendously developed buttress roots, in this and other respects resembling closely a New Zealand *Laurelia*. The Patamona name for it is *asheroa*. A fourth, which covered larger areas than any of the others, showed a curious natural coppice-formation rising from huge elevated composite boles.

There are, however, in addition extensive savannah lands at intervals *en route*. The most important may be briefly mentioned, in the order in which they are encountered. The Kurasabai savannah is extensive, and is remarkable for a much more varied grass vegetation than the main Rupununi. Among these other grasses are evidently some which form exceptionally good fodder, for I noted " the cattle looked the sleekest and fattest I have seen in the region, with backs reminiscent of Smithfield. " Ichilibar savannah is even larger, but in its western portion at least, is very stony and the pasturage sparse and poor. Further north between Ichilibar and Kerikabaru there are several long stretches of upland savannah, and here for the first time the dominance of the main Rupununi grass is disputed by another species (*Paspalum contractum*) which frequently covers large areas almost to the exclusion of other plants. This is a definite loss from the ranching viewpoint, since this grass has a conspicuous flower-head but very scanty leafage. None of the savannahs between here and Roraima is stocked. At Roraima itself the Venezuelan Boundary Commission kept a small herd for beef. From the village of Ipisiau, on the Ireng, until we emerged into the upland savannah at the foot of the Roraima, we traversed almost continuous forest.

THE BRAZILIAN SAVANNAHS OF THE RIO BRANCO.

The return route from Roraima to the Uraricuera and thence, *via* Boa Vista to the Rupununi again, traversed savannah country almost entirely. In keeping with the successive changes in elevation and geological structure these savannahs showed a much greater variety of vegetation than those of the Rupununi. As one approached the Uraricuera and the Takutu Rivers, especially the Rio Branco itself, they differed also in being much more heavily stocked ; so much so that, as already indicated, there are considerable areas in which pasture deterioration has proceeded to its climax in pure stands of entirely inedible weeds (especially *Sida* and *Ipomoea crassicaulis*). In spite of this the types of cattle and horses throughout the Brazilian savannahs are usually markedly superior to those of the Rupununi.

The Hamilton Rice-Harvard Medical Expedition was very impressed by the wide prevalence of deficiency diseases and digestive troubles among the Brazilians of the Rio Branco savannahs. Thus Hamilton Rice writes that "the deleterious effects of the present ill-balanced, malnutritious dietary are very apparent in the generally adynamic condition of the majority of individuals presenting themselves for medical examination, advice and treatment". The regular consists almost exclusively of cassava farine and meat, chiefly in the dried form. I was particularly struck by the great contrast offered by the evident health of the savannah Indians living under very similar conditions and on the same diet—with this difference, that the Indians consume vast quantities cashiri, paiwari, parakari and other fermenting (rather than fermented) drinks, exceedingly rich in yeasts. The "civilisados" largely scorn these concoctions, and at the most drink them only when they visit Indian settlements. Personal experience indicated immediate benefit from these drinks whenever the above diet began to tell on the visitor. It seems eminently probable that their high vitamin content is a great factor in producing and maintaining the incomparably better health of the Indians. *Capsicum* peppers, which form such a regular, and to some palates, excessive feature of Indian diet, have lately been proved exceedingly rich in Vitamin C.

THE KANUKU MOUNTAINS.

The Kanuku Mountains, which split the Rupununi savannahs into two, are very much less known biologically than Roraima. At their summits, from 2,000 to 2,500 feet are a few areas of savannah land showing the same vegetation as that which occurs at similar elevations in the Pakaraimas, *e.g.*, just north of Ichilibar.

The most interesting find in the Kanukus, however, was a large "reef" of true wild cacao, shown me by Mr. John Melville. Its presence was first pointed out in this region by Mr. John Ogilvie. It is hoped to study this cacao at a later date, with a view to obtaining data on and perhaps assistance in, the biological control of cacao pests. It is curious that unlike the wild cacao examined by the writer on an affluent of the Coppename River in Dutch Guiana several years ago, these Kanuku trees were apparently entirely free from witchbroom disease though belonging to exactly the same uniform type as the Surinaam trees. They were in fact in a highly flourishing condition, but there was evidence that most of the pods were taken by monkeys, which are unusually abundant in these mountains.

THE CATTLE TRAIL.

The Cattle-trail from the Rupununi savannahs to those of the Berbice is a magnificent piece of work. The main problem still connected with it seems to be an entirely ecological one, namely to grow pasturage in the holding-paddocks *en route*, which on the one hand will endure during the dry season, periodic heavy stocking and trampling, and on the other hand, withstand during the

whole of the wet season the competition of the forest second-growth. The former is rendered exceptionally difficult by the loose sand which is the predominant soil from Kurupukarı downwards. Several of the holding-paddocks were as bare as a sea-beach.

It might be suggested that plants other than grasses and the usual legumes be investigated for feeding qualities and palatability, especially those which form common constituents of second-growth forest on the cattle-trail or in other parts of the Colony. In New Zealand it is customary in certain districts to tide the dairy cattle over bad times by felling and feeding to them the foliage of some of the forest trees, notably *Griselinia littoralis*, and the introduced willow (*Salix* spp.) On the trail we were informed that where pasture was lacking we could feed the pack-bullocks with trumpet-tree (*Cecropia*) and turu palm (*Oenocarpus*).

The former is a common second-growth plant, and it would not be difficult to grow pure stands of it on cleared forest land, where browsing itself would keep it short enough to obviate felling. But we found that only with the greatest difficulty could our pack-animals be persuaded to eat either of these plants. Major Bone informs me that considerable patience is necessary to accustom the savannah cattle to this strange food. Under these circumstances the establishment of grass paddocks is naturally the only course. The pack-bullocks ate young bracken (*Pteridium esculentum*) and several unidentified forest trees more readily than the above two plants.

In conclusion, though this is not the place to acknowledge the assistance freely given by numerous authorities and ranchers on the Brazilian and Venezuelan sides, I should like to express my appreciation and gratitude for the very great and enthusiastic help and courtesies rendered to us by the ranchers of the Rupununi, the Commissioner, Mr. Haynes, the Land Officer, Mr. E. E. Melville, and the Chief and Secretary of the British Boundary Commission. The identification of the grasses was kindly made or at least confirmed, by Dr. A. S. Hitchcock.

A STUDY OF PRICES AND WAGES, CHIEFLY AGRICULTURAL, IN BRITISH GUIANA, 1910-32

BY

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Introduction

Agriculture is primarily a business and one of the effects of a depression is to emphasize the principle. If enquiries are made from an agricultural department or similar advisory body about a breed of fowl, or a fertilizer, or a piece of machinery, answers to such enquiries are expected to be substantiated with figures ; when the margin of profit is wide the agriculturist is, perhaps, prone to act on the basis of general opinions ; when the margin becomes narrower he cannot afford, and is unwilling, to do this. Information must be more specific.

In the pursuit of agriculture—as in any other business—a factor of outstanding importance is that of prices ; this is especially apparent during periods of economic depression when prices fluctuate violently and continuously, and within recent times, questions bearing on the changes in the prices of products are among the most numerous that have arisen for consideration in this Department.

If the general economic situation is stable, one can obtain a comparatively accurate impression of the effect which a change in the price of a commodity may have on those concerned in producing that commodity. When violent changes in prices, such as those in recent years, take place, a superficial study of price fluctuations may be definitely misleading. Thus, even though the prices of commodities have dropped, the prices of some commodities have fallen more than in the case of others. If, for example, rice selling prices fall 5 per cent., but the cost of labour and of other items of production falls 6 per cent., foodstuffs 8 per cent., and clothing and other living expenses 10 per cent., then the rice farmer is in a better position than he was before his prices fell. His purchasing power will have increased. Hence, in periods such as the present, fluctuations in the price of a commodity should not be studied independently of fluctuations in the prices of related commodities if due significance of the changes is to be appreciated. The use of index numbers is the universal method adopted for depicting price changes in such a manner that these changes, even in different commodities, may be easily comparable.

INDEX NUMBERS.

The phrase "index number" is applied to a series in which a selected term is assumed to be 100 and the other terms expressed as percentages of it. If, for example, the price of padi per bag were $1.00 in 1914 and $2.00 in 1920, the corresponding index numbers for padi prices, when 1914 is taken as the base period, would be 100 for 1914 and 200 for 1920.

The calculation and use of index numbers have become so general throughout the world that it seemed that a useful purpose might be served if the index numbers of prices of some commodities, which were of importance to the Colony in general and to the agricultural industries in particular, were computed.

The index numbers first calculated by the writer are those of the ten important export products of British Guiana for the period 1917-32 (Table I). The ten are sugar, rum, molasses, rice, coconuts, coffee, timber, balata, diamonds and gold. The original price quotations, from which these index numbers are computed, were obtained from the *Annual Reports of the Comptroller of Customs* and are therefore f.o.b. prices.

TABLE I.

Index of prices of the chief commodities produced in British Guiana.

1910—1914=100.

Years	Sugar	Rum	Coco-nuts	Rice	Molass-es	Coffee	Tim-ber	Bala-ta	Dia-monds	Gold
1917	172	300	139	153	95	111	143	107	139	105
1918	173	173	129	165	163	89	137	125	167	95
1919	234	208	195	212	195	121	197	125	328	98
1920	393	377	233	218	100	148	266	130	437	114
1921	152	304	117	216	77	61	240	125	197	126
1922	129	146	68	106	122	77	286	116	308	107
1923	201	176	88	106	122	84	223	109	295	107
1924	161	181	101	108	36	96	211	107	292	103
1925	113	188	162	117	36	151	200	107	275	108
1926	117	192	147	116	23	151	234	107	290	103
1927	131	185	115	97	23	141	214	93	255	101
1928	116	173	118	95	27	132	223	71	241	102
1929	97	169	106	96	23	101	220	70	227	98
1930	77	165	80	75	23	54	223	70	179	101
1931	73	180	58	69	23	37	206	61	104	93
1932	77	169	70	64	23	58	194	41	121	109

Prices of commodities have undergone such marked fluctuations during the period under consideration that it is not easy systematically to study these figures without resorting to some pre-war basis for comparison. For this reason the index numbers (Table I) are calculated with the average of the five pre-war years (1910-14) taken as 100. The index number of the export price of sugar in 1932 was 77 (Table I); this therefore means that the f.o.b. price received by British Guiana sugar producers in 1932 was 77 cents as compared with $1.00 in 1910-1914; the price of diamonds was $1.21 in 1932 as compared with $1.00 in the 1910-14 pre-war period.

It can be seen that the prices of agricultural commodities (with the exception of rum) have, since 1930, been below pre-war prices; this has not been so in the case of gold, diamonds, and timber and this may give some indication of the reason why so many complaints have been heard in recent years of agricultural labour moving towards the cities, the gold and diamond fields. The amount of labour demanded on timber grants is not excessive but it was probably easier for timber to pay for such labour during 1932 than seven years previously; timber prices in 1932, although lower than in post-war times, were high in relation to the prices of agricultural products. The index for balata in 1932 was 41 (as compared with 100 pre-war); the price was, in relation to the prices even of agricultural products, low, and balata, once an important article of trade in this Colony, is now hardly sought.

Index numbers may thus be used in comparing price movements in different commodities no matter how unrelated and in different periods, no matter how far separated. By this means the changes in price per gallon of rum can be compared with the changes in price per ton of sugar, per bag of rice, per foot of greenheart or per ounce of gold.

The export price of coffee from 1925 to 1929 was above the pre-war price, but the index fell to 54 in 1930 and still further to 37 in 1931. The situation became so critical in the coffee-growing areas of the Colony that, in 1931, Government found it necessary to appoint a Coffee Committee to "consider what steps should be taken to improve and assist the coffee industry of the Colony". Coffee prices were violently and suddenly thrown out of adjustment with other prices, and, in all those areas of the Colony substantially dependent on coffee, business and trade had, almost completely, to be suspended. Coffee prices rose from 37 in 1931 to 58 in 1932 (Table 1) thus returning more into relation with other prices, and the disorganised coffee industry of 1930 was materially rehabilitated before the end of 1932.

In the case of sugar the drop in prices from 116 in 1928 to 97 in 1929 and to 77 in 1930 must necessarily have corresponded closely with what happened in the British West Indies since the preferential prices received are the same in both cases. Sugar prices had thus fallen out of alignment with other prices and this had so grave an effect on the industry that in 1929 His Majesty's Secretary of State for the Colonies considered it expedient to appoint a Sugar Commission

to recommend, *inter alia*, "any measures . . . desirable . . . . for the assistance of the industry" of the Caribbean. Some measure of protection was afforded Colonial sugar and this, together with favourable Canadian exchange rates, was mainly responsible for the rise in price of British Guiana sugar from an index of 73 in 1931 to an index of 77 in 1932; a responsible factor contributing to the improved financial condition of the Colony in 1932 is indicated by these figures.

Of the agricultural products under consideration rum prices are considerably the highest. It might have been expected that, in the light of this favourable price, production of that commodity would have advanced rapidly. This has not taken place, and the figures (Table Ib) disclose that the trend has been in the opposite direction; for the last four years (1929-32) both the production and exports of rum have consistently declined. With an import duty into the

TABLE IB.

British Guiana Rum Production and Exports and Molasses Exports.

Year	Rum Production	Rum Exports	Molasses Exports.
	Proof Gallons	Proof Gallons	Gallons
1919	3,464,403	4,342,769	171,249
1920	2,810,685	1,772,178	420
1921	1,806,651	2,228,164	204
1922	520,141	422,168	76,574
1923	1,180,072	420,996	65,997
1924	2,077,619	769,304	1,160,757
1925	1,277,900	1,148,124	1,345,243
1926	1,622,966	789,643	2,017,862
1927	1,436,010	1,081,120	2,677,457
1928	1,745,293	1,269,923	2,873,468
1929	1,838,353	1,109,482	2,536,623
1930	1,571,371	846,319	3,851,337
1931	1,002,267	722,076	7,106,997
1932	840,617	645,511	7,554,520

United Kingdom of $2,027 per puncheon (of 155 proof gallons) the price of rum on the Colony's most important market (the United Kingdom) became little different from that of whisky; in addition, rum production in certain of the Empire sugar producing countries (*e.g.*, Australia) for protected home markets, has advanced. There has, therefore, been no increased demand and a definite policy of restriction of the rum output has been pursued by the sugar interests of this Colony. Similarly, this explains how it is that molasses exports increased as consistently as rum exports fell. It was not that the price of molasses was attractive—the index

of 23 for molasses (Table I) is lower than the index of any other commodity—but with a diminishing rum production there was no alternative but to sell molasses as such, even at a much reduced price. On these grounds, it may be forecasted that, if the demand on the United Kingdom market should increase, local production and exports of rum can and will promptly respond.

In the case of rice, the price index has fallen for the last three years. That the industry should make some attempt to raise prices was almost inevitable. Regulations to ensure rice grading and blending, a Bill to promote factory practices more equitable to the grower and a Rice Marketing Board followed in quick succession. It might be an interesting and perhaps instructive undertaking to trace the association which may exist between the amount of agricultural legislation enacted in a country and the fluctuations in price level of commodities produced in that country.

In order to discover what was the *general* situation in the colony in regard to export prices a single index for each year based on the index numbers of the individual export products was next computed (Table II). To obtain a single index for each year the index of each export product (Table I) was weighted in proportion to relative value, *i.e.*, the index of each export product was multiplied by a figure representing the percentage of the Colony's export trade contributed by the respective products. The figure in Table II for each year is therefore a weighted index.

TABLE II.

Weighted index of prices of the chief commodities produced in British Guiana. 1910—1914=100.

Years.	Weighted Index Numbers.
1917	170
1918	160
1919	207
1920	332
1921	164
1922	129
1923	179
1924	152
1925	121
1926	124
1927	130
1928	118
1929	104
1930	90
1931	86
1932	88

As sugar forms so high a percentage of the exports the index is in consequence heavily weighted by the fluctuations in sugar prices. It can be seen that the general export price level in 1932 was 88 compared with 100 pre-war, but showed an improvement over the 1931 level. This means that the quantity of exports which in the pre-war period could be sold for $1.00 was sold only for $0.88 in 1932; this same quantity of exports would however, have been worth $2.07 in 1919, $3.32 in 1920 and $1.64 in 1921 (Table II). This may indicate why 1921 and 1922 were years of such economic distress in this Colony; although the export price level was much higher in 1921 than in more recent years production costs had not then become adjusted as, to a certain extent, they since have, and the figures show that the 1921 collapse must have profoundly shaken the Colony's economic structure. This is reflected by the fact that the Colony balanced its budget easily in 1920 with an excess of over £260,000; in 1921 there was a deficit of nearly £230,000; in 1923 the export index rose to 179 (Table II) and the budget was again balanced. The East Bank riot in 1924 was associated with the general dissatisfaction which may make its appearance when years of high prices are followed by a price collapse such as that indicated (Table II). It is relevant that in the *Official Receiver's Annual Reports* it is recorded that there were 31 insolvencies in 1921 and 52 in 1922 as compared with 9 in 1920. It is interesting to note that although the level of export prices is very low at the present time, business re-adjustments have been taking place, many of the less sound commercial firms and agricultural estates have not survived: the number of insolvencies is in consequence considerably less than in 1921 and the years immediately succeeding. In 1931, there were only 9 insolvencies and 7 in 1932 (*Official Receiver's Reports.*)

It next seemed desirable to ascertain the relationship between the country's income (which is derived mainly from exports) and the prices of certain articles which, entering largely into local consumption, have an important bearing on the general cost of living. Consideration has thus far been given to the trend in prices of the Colony's exports, but it is even more important to determine how export prices fluctuated in relation to prices of those articles affecting the local cost of living. The fact that sugar prices have fallen does not in itself necessarily inflict any hardship on the sugar producer; what does inflict hardship is if sugar prices fall and get out of relationship with capital investment, wages, taxes and the cost of the items which contribute to living cost and production cost. In other words, hardship is caused to the sugar producer when the purchasing power of sugar falls. To obtain an indication of how the purchasing power of the Colony fluctuated the index numbers of the prices of 11 important commodities produced locally (Table III) and of 17 imported articles (Table IV) entering largely into local consumption were calculated for the same period and on the same base.

The base period used is 1925—27, *i.e.*, the average price of 1925, 1926, and 1927 is taken as 100. It might have been preferable to have a pre-war base so that comparison could be made between recent prices and pre-war prices; such

TABLE III.

Index of prices of the chief commodities produced in British Guiana.

1925—1927=100.

Years	Sugar	Rum	Molasses	Rice	Coconuts	Coffee	Timber	Balata	Diamonds	Gold	Bauxite
1920	326.0	200.0	366.7	198.4	164.7	100.4	122.4	128.0	160.1	109.6	92.4
1921	126.6	161.2	283.4	196.7	82.4	41.0	110.5	122.7	72.0	120.4	93.2
1922	107.5	77.6	450.1	96.2	48.0	52.1	131.6	114.0	112.9	103.1	...
1923	167.0	93.9	450.1	96.8	61.5	57.2	102.6	107.0	107.8	102.7	105.2
1924	134.0	95.9	133.4	98.2	71.0	65.2	97.4	105.2	106.8	98.7	101.0
1925	94.2	100.0	133.4	106.4	114.0	102.3	92.1	105.2	100.6	103.6	100.8
1926	97.0	102.0	83.4	105.2	104.1	102.3	107.9	105.2	106.1	99.0	99.6
1927	108.8	98.0	83.4	88.4	81.4	95.4	98.7	91 2	93.3	97.2	99.6
1928	96.2	91.8	100.0	86.6	83.3	89.4	102.6	70.2	88.4	98.0	99.6
1929	80.3	89.8	83.4	87.4	75.1	68.4	101.3	68.4	82.9	94.4	99.6
1930	64.2	87.8	83.4	68.1	56.6	36.4	102.6	68.4	65.4	97.1	99.6
1931	60.5	95.9	83.4	63.0	41.2	25.2	94.8	59.6	38.1	89.4	99.6
1932	63.8	89.8	83.4	58.5	49.3	39.2	89.3	40.3	44.2	104.6	153.2

figures could not have been reliably obtained in the present instance since the prices on which Table IV is based were extracted from the "*Commercial Review*", the organ of the Georgetown Chamber of Commerce, and this publication first

TABLE IV.

Index of prices of commodities which have an important relation to the cost of living in British Guiana.

1925—1927=100.

Yrs.	Beef	Dholl	SCALE FISH Canadian	SCALE FISH English	Flour (Super)	Lumber (White Pine)	Kerosene Oil	Coconut Oil	Soya Oil	Gasolene	Peas (Split)	Potatoes	Pork	TOBACCO Leaf	TOBACCO Manufactured
1920	144.1	170.0	144.8	114.7	179.8	150.2	137.2	257.0	...	145.1	264.0	258.8	178.2	109.6	83.4
1921	120.0	164.4	99 8	91.7	123.6	151.3	121.8	92.8	...	154.9	173.2	139.9	111.8	...	86.6
1922	84.1	131.4	106.7	107.1	95.1	101.6	87.0	78.5	...	111.8	172.6	111.8	93.1	...	111.2
1923	99.0	87.3	90.0	91.0	88.5	96.2	83.0	83.3	...	98.0	132.7	92.1	89.2	...	101.4
1924	96.7	86.4	124.2	131.0	97.0	110.9	100.6	109.5	110.8	105.9	122.0	114.6	93.9	97.1	98.6
1925	100.0	92.3	113.8	113.3	108.1	102.8	100.2	104.2	110.0	100.0	102.9	91.5	111.8	101.0	100.3
1926	108.9	91.6	96.4	94.6	103.4	98.9	99.7	89.2	...	92.2	96.6	114.8	99.7	101.9	100.3
1927	91.0	116.0	89.8	100.0	88.4	98.2	100.0	96.4	89.1	109.8	100.6	93.8	88.5	97.1	99.7
1928	104.8	107.1	98.8	92.1	93.0	98.2	99.7	94.0	88.3	103.7	92.9	87.9	81.8	97.1	101.4
1929	100.2	107.4	105.4	109.1	85.4	98.2	99.8	83.3	84.1	113.7	97.6	87.9	79.3	96.2	93.6
1930	88.6	95.8	112.1	106.4	75.6	94.3	99.8	80.9	81.6	113.7	90.8	77.8	77.6	99.0	97.6
1931	61.7	82.0	105.9	80.3	62.3	91.5	99.8	72.3	69.1	113.7	65.1	81.1	64.0	97.1	97.6
1932	71.9	83.4	79.4	81.0	63.2	102.0	99.8	69.0	70.4	113.7	64.8	80.7	66.9	98.1	97.0

appeared in 1919. The period 1925—27 was chosen as the base because it is well separated from the post-war crash (which, the figures indicate, occurred in 1921–22 in this Colony), and is, on the other hand, not usually associated with the advanced economic depression of the present day; hence the period serves as a convenient standard with which comparison may be made.

It can be observed that the articles included in Table IV make up a varied and moderately representative collection of commodities which enter into the cost of living of the inhabitants of this country. It is regrettable that no article used for clothing has been included, since definite information on this subject may have been informative. The writer made various attempts to obtain the figures but was not successful, the basic information on local prices being inadequate.

To provide a single and comparable figure for each year to indicate the price situation in regard to export products and the imported articles which affect the local cost of living, a weighted index for all the export articles in Table III and a corresponding weighted index for imported articles in Table IV were then computed (Tables V and VI). From these (Tables V and VI) it is indicated that the general economic situation was better, in this Colony, in 1932 than in 1931, because, whereas the index of imported articles of consumption rose 2 points or approximately 3 per cent. (from 79.2 to 81.6), the export products which largely provide the Colony's income rose approximately 6 points or 10 per cent. (from 58.8 to 64.6).

TABLE V.

Weighted Index of prices of the chief commodities produced in and exported from British Guiana.

1925—1927=100.

Years.	Weighted Index Numbers.
1920	245.0
1921	114.3
1922	110.1
1923	140.2
1924	119.4
1925	97.9
1926	100.4
1927	101.7
1928	93.0
1929	82.7
1930	68.5
1931	58.8
1932	64.6

The index of export prices has fallen considerably each year since 1927 and the index of imports since 1928. There can be little doubt that the change for the better in 1932 was in a large measure due to the advantageous exchange rates on the Canadian and United States markets. This index also shows that in 1932 the rise in prices of the Colony's exports was the biggest, and hence the most favourable, since 1924. For the period studied (1920—32), imported articles for consumption have fallen in price but not as low as in the case of local commodities sold abroad.

TABLE VI.

Weighted index of prices of imported commodities which have an important relation to the cost of living in British Guiana.

1925—1927=100.

Years.	Weighted Index Numbers.
1920	163.9
1921	118.8
1922	103.1
1923	94.1
1924	103.0
1925	104.2
1926	101.0
1927	94.3
1928	95.7
1929	92.7
1930	88.1
1931	79.2
1932	81.6

The index numbers of articles which, produced in this Colony, enter largely into local consumption were next computed (Table VII); the figures indicate as clearly as will an explanation how and to what extent the several industries have been affected by falling prices and also throw further light on the cost of living in the Colony during the years under review. There are no reliable figures available in regard to the quantities consumed locally. It is not therefore possible to compute a weighted annual index for commodities produced in the Colony and consumed locally.

TABLE VII.

Index of prices (ruling in Georgetown) of commodities which, produced in British Guiana, enter into local consumption and are so related to local cost of living.

1925—1927=100.

Years	Rice	Timber (Greenheart)	Coconuts	Copra	Coffee (Liberian)	SUGAR Dark	SUGAR Yellow	SUGAR White	Rum
1920	70.0	...	216.1	...	89.4	201.5	184.8	247.9	294.4
1921	135.0	136.4	94.2	...	47.0	144.6	141.3	247.9	139.6
1922	92.4	90.9	51.6	...	57.0	108.3	110.4	...	103.8
1923	93.7	81.8	52.1	...	58.8	168.7	156.3	...	103.8
1924	88.7	100.0	63.5	...	80.6	172.9	184.8	...	103.8
1925	94.1	100.0	105.7	...	96.5	93.1	107.6	106.0	103.8
1926	118.8	100.0	100.0	100.0	105.9	99.1	86.3	91.5	103.8
1927	87.2	100.0	93.7	97.8	98.2	107.7	105.9	102.5	94.4
1928	88.0	100.0	93.7	97.8	84.1	95.5	92.9	93.0	94.4
1929	85.8	100.0	93.7	78.3	70.6	79.8	77.4	77.5	92.5
1930	67.9	100.0	93.7	70.6	40.0	81.2	76.1	78.7	96.2
1931	58.0	100.0	72.9	52.2	26.5	83.3	76.1	88.8	98.1
1932	54.9	65.8	51.0	50.0	40.6	98.2	97.0	98.1	98.1

WAGES.

An attempt was next made to discover what changes had taken place in the wages paid to different classes of workers. The average daily wages of a carpenter, a mason, a cane-cutter, a shovel-man, a weeder, a male and a female agricultural labourer and a 'creole' were obtained from the Colony's annual *Blue Books* from 1910—32 (Table VIII). Unfortunately for the purposes of this study, the system of wage recording in these publications was changed in 1926; the necessary data could be obtained for carpenters, masons, cane-cutters, shovel-men and weeders from 1910—26, but the information in regard to masons, cane-cutters, shovel-men and weeders ceased to appear and from that date the wages of male and female agricultural labourers and 'creoles' were substituted.

As the wage data were not in a comparable form, a wage index was not computed. It can be seen that carpenters' wages (the only continuous series) have not fallen in the same ratio as have the prices of the commodities chosen to give an indication of the cost of living. The same is probably true in the case of other classes of wage-earners in the Colony, because it is characteristic that

in periods of rising or falling prices there is always a lag in wages. When prices of commodities rise wages do not tend to rise as quickly and when prices fall wages decline less rapidly. Thus, during the war and post-war years when prices were high, the wage and salary earners were those who complained

TABLE VIII.

Average wages paid per day in British Guiana.

Years	Carpenters	Masons	Cane-Cutters	Shovelmen	Weeders	Men	Women	Creoles
	$	$	$	$	$	$	$	$
1910	1.00	1.00	.60	.36	.28	...	...	...
1911	1.00	1.00	.60	.36	.28	...	...	...
1912	1.00	1.00	.60	.36	.28	...	...	...
1913	1.00	1.00	.60	.36	.28	...	...	...
1914	1.00	1.00	.60	.36	.28	...	...	...
1915	1.00	1.00	.60	.36	.28	...	...	...
1916	1.08	1.08	.60	.36	.28	...	...	...
1917	1.20	1.32	.96	.60	.37	...	...	...
1918	1.38	1.56	1.44	.60	.40	...	...	...
1919	1.72	1.92	1.44	.60	.40	...	...	...
1920	1.80	1.80	1.65	.95	.61	...	...	...
1921	2.20	2.64	.76	.56	.40	...	...	...
1922	1.44	2.44	.66	.56	.40	...	...	...
1923	1.92	1.74	.66	.56	.40	...	...	...
1924	1.92	1.74	.66	.56	.40	...	...	...
1925	1.72	1.74	.66	.56	.40	...	...	...
1926	1.65	...	...	...	...	.48	.32	.22
1927	1.65	...	...	...	...	.48	.34	.22
1928	1.65	...	...	...	...	.48	.34	.22
1929	1.65	...	...	...	...	.48	.34	.22
1930	1.65	...	...	...	...	.48	.34	.22
1931	1.65	...	...	...	...	.56	.32	.18
1932	1.65					.44	.28	.15

most bitterly. This relationship is responsible for the general conception that, during a depression such as the present, the wage-earner is in comparatively fortunate circumstances. This may to a certain extent be misleading because it should be remembered that the wage quoted is that paid to *employed persons;* during a depression unemployment increases (as is the present experience in British Guiana), and those who are unemployed become largely dependent for support on those who are employed. The demands on the average wage increase,

SUMMARY.

In the conducting of business a factor of outstanding importance is that of prices, and this is especially apparent during periods of economic depression when prices fluctuate violently ; as agriculture is a business, price fluctuation is one of the subjects which, within recent years especially, have demanded considerable attention and study from those connected with the agricultural industries of the Colony.

An attempt has been made by the writer to study price movements of agricultural and other products in the Colony. The use of index numbers is the universal method employed to depict price changes in an easily understandable manner so that price changes even of different commodities and at different times may be easily compared. The phrase "index number" is applied to a series in which a selected term is assumed to be 100 and the other terms expressed as percentages of the selected term. Thus, if the price of sugar per ton were $70.00 in 1914 and $140.00 in 1919 (and such approximately were the prices for these years) the corresponding index number for sugar prices when 1914 is taken as the base period would be 100 for 1914 and 200 for 1919. By expressing the prices of the different commodities as index numbers the change in price per ton of sugar can be compared with the change in price per bag of rice, per gallon of gasolene, per pound of beef or per ounce of gold. The price changes and some of the consequences of these changes have been traced.

Index numbers were computed for the following :—

(a) Important commodities produced in and exported from British Guiana ;

(b) Commodities produced abroad, imported and contributing largely to the cost of living ;

(c) Commodities produced locally, consumed locally, and contributing largely to the cost of living.

Whenever possible, a single weighted index was computed for each year in order to give a general indication of the price situation. This paper describes the position to the end of 1932 as at the time of writing the 1933 figures are not yet available. It is intended to calculate the index numbers for the later period and these it is anticipated will be published in due course. As this Department is now computing and keeping a record of regular f.o.b. price quotations for important products of the Colony, it should in future be possible to keep these index tables up-to-date. This should serve to increase the use of the figures for current reference purposes.

The use of index numbers is becoming so general, especially for their value in permitting those who are interested to gauge the significance of price changes, that it is hoped that the figures herein supplied will be of some service to those connected with the business of the Colony in general and the agricultural industries in particular.

LIVESTOCK NOTES.

BY

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PIG-KEEPING ON THE COAST.

In 1929, a boar and two sows of Canadian-Berkshire breed were imported by the Department of Agriculture. Open-air breeding was adopted; that is, a dry, well ventilated, cool and shady house was provided, and a run of approximately one-eighth of an acre was allowed for each animal. A large bath was placed in each run.

The pigs settled down to their new environment immediately; no period of acclimatisation was required. A balanced food ration was provided.

The pigs have remained healthy, have bred well and the weights and numbers of the litters reared have been highly satisfactory.

The land on which the pigs are kept is similar to most of the coast; it is baked hard in dry weather and is more or less a swamp in wet weather. The site is changed half-yearly.

Young pigs are weaned at eight weeks, and generally two litters are reared by each sow annually.

Trials with various foodstuffs have been made, including imported meat and fish meals. The most economical ration, and one which has given satisfactory results for breeding pigs is:

Coconut Meal—50 lbs.
Broken Rice—40 lbs.
Crushed Peas—10 lbs.

This is supplemented with a mineral mixture of lime flour and bone meal in equal parts of 1 lb. 3 ozs., common salt 10 ozs., ferric oxide 2 ozs., and potassium iodide, 15 grains.

The pigs are fed morning and evening with the above meal mixture damped with molasses water, allowing up to one quarter of a pound of molasses for each mature sow or boar. At mid-day a bundle of Demerara Primrose or grass and a small quantity of chopped Uba cane are given. Drinking water is kept before the animals at all times. Young pigs are gradually brought on to the same ration

supplemented with small quantities of milk when available. The peas are the expensive ingredient of the ration. Pigeon peas are easily grown, but cost as much to reap as imported peas.

A second consignment of the same breed has been imported from Canada and has given just as satisfactory results as the first. Approximately forty young pigs have been distributed each year. When managed more or less under the same conditions as on the farm or allowed extensive grazing on good savannah land the results have been satisfactory.

The climatic conditions of the coast are excellent for pig-rearing, and the Canadian Berkshire breed gives good results, but the very narrow margin between cost of foodstuffs and the local market prices for pigs prevents swine husbandry being a popular industry.

Pig-keeping on a more or less large scale is profitable for stock-owners with extensive rough grazing, distant from cultivation, where the pigs can forage for roots, grubs, young grass and fish, and when this food is supplemented with rice and molasses. It is equally profitable for manufacturers of coconut oil who feed the by-products of their factories supplemented with rice, molasses and grazing ; but the sty-feeding of pigs with purchased foodstuffs at present prices is unprofitable. The waste products of the average farm are small in amount, and unless supplemented with other foodstuffs do not make a satisfactory ration. Rice dust, the waste of rice mills, supplemented with molasses water and scavenging in the villages and on waste lands is a common method of feeding pigs. It is not a method to be recommended and should be abolished. The waste lands and villages are no substitute for good savannah land and rice dust, while not entirely without nourishment, is not a suitable diet for a pig.

At present prices pig-breeding is not a profitable occupation or side-line for anyone who is not in a position to take full advantage of the natural resources of the Colony. There is an export market for pigs and that it is more profitable than the local one can be judged by the fact that whenever reasonable transport is available pigs intended for the local market are exported. The export market is one which should receive the atttention of all breeders who are in a position to carry on under present conditions on a more or less large scale.

Milk Cattle of the Coast.

The cattle of the coast districts are general purpose animals in that they are used for milk, beef, or work according to the requirements of their owners ; but the primary object of the majority of the cattle owners is the sale of milk.

Two systems of management are practised. Under one system the cattle find their living on the pastures and receive no supplementary food ; and under the other the animals are kept in stables and are fed with cut grass and concentrates. The pasture-fed animals cannot properly be termed milk cattle ; their

yield of milk is low and the period of lactation short. Their owners obtain the amount of milk required by keeping numerous cows; three or four pints of milk from each animal make up the gallons.

Most of the grazing areas of the coast are no better than exercise grounds in dry weather and swamps in wet weather; for the greater part of the year, the cattle are girth deep in mud and water, and for the remainder are on a semi-starvation diet. The production of clean milk under these conditions is not possible without a large increase of labour which the low wholesale price of milk does not warrant. The present intensive system of management is carried to the other extreme. Cow-keepers, each owning a few animals, have settled in the city and the neighbouring villages. The cows are kept in stables erected in small yards, and are fed with concentrates and cut grass, obtained from the back-dams of estates. Roadside grazing is practised whenever possible. Most of the cows are selected animals yielding one or more gallons of milk daily. The milk is sold retail. Three or four cows support a family and all members of the family attend the animals, cut grass, and deliver milk. The construction of the stables is governed by regulations and the buildings are permanent structures with concrete floors.

In other countries the tendency is to remove dairy stables away from towns and villages, and to use the improved transport conditions for delivery of the milk. It is undesirable to keep cattle in residential areas especially when the stables are open as is necessary in the Colony, but the circumstances are peculiar and at the present time the removal of milk cattle to country districts is not practical.

The main supply of milk is in the hands of small producers. Suitable land on which forage can be grown or on which milk cattle can be grazed requires capital, and moreover, is difficult to find within reasonable transport distance of the city. It is cheaper and easier for cow-keepers to obtain permission to cut grass on the back-dams of sugar estates. The time taken to collect grass and the manner of transport is of no importance to the cow-keeper who has a family, whereas the transport of milk requires to be done expeditiously in that the small producer is unable to provide the necessary plant for cooling. The wholesale price of milk is low. Double the number of cows is required to produce the same profit when milk is sold wholesale as when sold retail. The cow-keeper with a family has no labour to pay and so prefers to sell retail.

From the point of view of a clean milk supply it is undesirable to have a multitude of small producers retailing milk because their methods of handling the product cannot be efficiently supervised, and for the milk trade in general it is unsatisfactory because of the cutting of prices. But apart from sugar this is a Colony of small producers, and the production of milk is no exception. In the course of time a few of the present small milk producers may amass sufficient capital to extend on a larger scale with their own dairy and sterilising plant.

In the meantime, there are several important improvements which all cow-keepers can make.

(*a*) *Improvement of Breed*:—For a number of years cow-keepers in the Georgetown area have bred their cows to Holstein-Friesian bulls owned by the Government. Heifers, the progeny of this cross, are now with first calf and have shown a great improvement on their dams in milk yield. Hitherto a very wide discretion has been practised as to the type of cow accepted for service. The time has now arrived when cow-owners should practise careful selection of the animals from which they wish to breed. Cows for breeding purposes should have good records, and heifers should be well grown and of good milk type.

(*b*) *Feeding of Cows*:—There are many excellent proprietary meals manufactured in other countries but their cost on importation is prohibitive at the present milk prices, and there are very few locally grown products which can be economically fed to live-stock. A mixture which is by no means ideal, but which has given satisfactory results and is of comparatively low cost consists of:

Broken Rice	60 lb.
Coconut Meal	20 lb.
Barbadian Cotton Seed Meal ...	20 lb.

This is supplemented with a mineral mixture of common salt—1 lb. 3 ozs. lime flour—1 lb. 3 ozs., bone meal—10 ozs. and potassium iodide—22 grs. Morning and evening feeds are given damped with molasses water, allowing up to half a pound of molasses per animal daily.

The average good creole cow will give one gallon of milk when receiving a ration of the selected grasses collected from the back-dams and maintain its condition. About $3\frac{1}{2}$ lb. of the mixture are required for the second gallon, or approximately one pint measure of meal for each pint of milk over one gallon. A liberal and clean water supply is required and if possible water should be kept in front of the cows at all times.

(*c*) *Rearing of Calves*:—A satisfactory and economical method of feeding calves in the Colony has yet to be discovered. It is a simple matter for cow-keepers with surplus milk or for anyone who rears pedigree or pure-bred stock which sell at high prices, but it is a difficult problem for the dairyman who requires all the milk he can obtain for sale. Imported calf meals are expensive, local products are not satisfactory, and there is no skim milk.

At the present time, half-bred Friesian stock which have been well reared sell at high prices, and for the time being it is advisable to feed such calves as if they were pure-bred. Many milk producers have difficulty in disposing of the evening milk. It cannot be kept in its raw condition until the following day for lack of cold storage. Until a more satisfactory method of dealing with evening milk is found it is suggested that it should be scalded and be used for calf rearing.

A bulletin of the Ministry of Agriculture, England, recommends the following calf meal when a small quantity of separated milk is available :—

Oat Meal	...	...	8 parts by weight
Ground Linseed		...	1 part „ „

Scald 2½ lb. over night with 5 pints of boiling water, boil for ten minutes next morning and add 5 pints of separated milk with about ¼ oz. of salt and 2 ozs. of sugar.

The scalded evening milk should be skimmed and be used in place of separated milk. The gruel should be thinned down with water to the required consistency.

For the first three weeks of the calf's life it should be fed whole milk. The substitution of the scalded evening milk and meal should be made gradually during the fourth week. After the fourth week small quantities of grass or Demerara Primrose should be allowed, and small quantities of a dry meal consisting of bran and ground rice or bran, rice and coconut meal.

It should be noted that half-bred heifers and bulls wholly reared in stables and kept tick-free are susceptible to tick-borne diseases when placed on the savannahs. To avoid losses from this cause it is advisable to allow the calves on to a grazing area early in life, say two or three months for short periods, gradually lengthening the period of grazing.

(d) *Cows in Stables* :—All animals kept in stables should be groomed once daily. The flanks of milk cows should be kept clipped. The udders should be washed before milking. Over-crowding should be avoided. Wet milking is commonly practised but dry milking would give cleaner results, or if this method is not acceptable it is more cleanly to use clean vaseline than dip the fingers in the milk.

(c) *Milk utensils*:—A milking pail with a dome, fitted with a filter pad would be an improvement. The sterilisation of all milk utensils after washing by placing them in a container attached to a steam boiler is not possible for the small producer, but the very thorough washing in really boiling water of all utensils should not be omitted.

POULTRY.

A few years ago, a Poultry Association was formed with the object of encouraging farmers and others to breed better fowls. It was realised that the membership of the Association would have to be strong and active if the Association was to achieve its object and poultry-keeping was to be made profitable.

Many valuable birds were imported by members, and eggs and chicks were distributed at very low prices. Successful exhibitions of poultry were held, and the original members of the Association gladly gave demonstrations and instruc-

tions in the handling and general management of poultry to all novices. There was a large increase of poultry-keepers who availed themselves of the opportunity to secure pure-bred birds at low prices, but none enrolled as members of the Association. The idea that an Association of many poultry-keepers could supply the markets with better eggs and birds and obtain reasonable prices for the improved products did not appeal to the average poultry-keeper who demanded proof of immediate individual benefit before being willing to join the Association. The Association could not guarantee immediate benefits, and the enthusiasm for poultry-keeping rapidly waned. At the present time, standard-bred birds, fit for exhibition or laying tests, are of no more value than their weight for table purposes, and all eggs are valued at local market prices. It is probable that the enthusiasm for the possession of pure-bred birds was caused by the low prices at which they were sold and not by an increased interest in poultry-keeping. For some years, it is probable that the breeding of standard fowls will be confined to a few fanciers who keep poultry as a hobby.

There is room for great improvement of poultry in the Colony, but the local market prices for eggs and table birds are much too low to attract anyone to invest capital in the purchase of birds of improved breeds. The local wholesale price for eggs of any quality is 15 cents per dozen, and the average price of a bird is 30 cents.

It has been demonstrated that pure-bred birds kept in clean areas but otherwise under the same conditions as common fowls give more and better eggs than the common fowl. Householders, who appreciate quality of egg and bird, will find that pure-bred birds pay for their keep even when kept intensively. But farmers and others who sell their eggs and birds in the local markets will find that the original cost of pure-bred birds makes a profit impossible.

It is possible to give the egg records of two pens of pure-bred white Leghorns kept under different conditions:

Pen 1:—This pen consisted of eight pullets. It was placed on a clean area and given ample room. A suitable house was provided, there was plenty of shade, and the water supply was good. A food mixture of local products was supplied together with grit. The birds ignored the poultry mixture and lived on the land. The land was the ordinary heavy soil of the coast covered with grass and with shallow pockets of water in which small fish lived. Insect life was plentiful. The birds were trap-nested and gave an average record of 191 eggs per bird, the majority being second grade or 1¾ oz. in weight. The lowest individual record was 163, and the highest 237. One bird died during the tenth month.

Pen 2. This consisted of 6 pullets of better type than No. 1. This pen was kept semi-intensively, a small grass run adjoined the house. The average record for the pen was 214 eggs, most of which were first grade, 2 ounces or over. The lowest record was 110; this bird stopped laying in the sixth month. The highest individual record was 261. The best record for size of egg was made by a

bird which laid 258 eggs. This bird finished her pullet year in excellent condition and proved a valuable breeder. Her record for three years is 258, 193 and 189.

The cost of the pullets in No. 1 pen was $5.00 per bird plus freight. The cost of food was practically nothing as the birds lived on the land. At present wholesale prices, 15 cents per dozen, the eggs of the bird with the highest record, 237, were worth approximately $2.96 or little more than half the original cost of the bird less freight. A flock of birds of similar type kept under similar conditions would have a lower average record, and at present egg prices would be a serious loss to the poultry keeper.

Common fowls kept in the City and villages or near rice dust heaps, according to poultry-keepers, have a mortality of 50%. In this case, the cost of renewals in the form of eggs set, or mature birds purchased, probably equals the value of the eggs and birds sold. As the fowls cost nothing in foodstuffs and no labour is entailed they pay for themselves. On the other hand, in clean areas, where common fowls are allowed open range, the mortality is low. Under these conditions the common fowl will lay an average of 60 eggs per annum, which represents 75 cents in the local market. Culls or birds which do not lay can be sold in the market at their original purchase price, 30 cents. For the farmer who desires to make a profit out of poultry-keeping a clean area on which the birds can find most or all their food is necessary. The fowls should be selected for their freedom from disease and internal and external parasites.

Primitive portable shelters to protect the birds from the rain and give shelter from the sun should be provided. These should be moved at intervals in order to keep the land clean. On heavy land grit should be provided and in all cases there should be a good supply of drinking water. Until market prices improve the poultry-keeper is advised to grade up his flock or flocks slowly by introducing cockerels of pure breed from time to time.

A NOTE ON PLANTAIN AND BANANA DISEASES IN BRITISH GUIANA WITH ESPECIAL REFERENCE TO WILT.

BY

E. B. MARTYN, B.A.,

Government Botanist and Mycologist.

The major disease of plantains and bananas in British Guiana is a wilt, which, though due to a variety of causes, and differing somewhat in the accompanying symptoms, results either in the gradual drying up and death of the plant, which fails to produce fruit, or in a more rapid withering and collapse, and decay of any fruit that it may be bearing when it succumbs.

Early records refer to a devastating disease which affected plantains on the coastlands in 1830, causing them to dry up and wilt. The observer suggested that it was due to the clearing of trees which had formerly acted as wind-breaks. A more detailed account of what was doubtless the same disease is given by Richard Schomburgk*. He says—"For some years past, an extremely peculiar "disease has introduced itself in the *Musa* plantations : this has become particu-"larly dangerous owing to its having proved so infective that if one shaft is "attacked, the whole plantation follows suit and perishes. Unfortunately one "has not yet found any remedy for this 'worm' disease, as the colonists call it.

"When the tree is attacked its outward appearance immediately shows it and "the whole plantation has to be cut down to prevent the further spread to others. "The disease itself starts from the innermost vascular bundles which take on a "brownish colour intermixed with a number of black spots. This decomposition "of the sap soon extends to the whole shaft. The growth of the plant as well as "that of the fruit is arrested and a resinous exudation renders the latter abso-"lutely uneatable. If the same piece of land is going to be replanted, suckers "from a healthy plant must be used, because experience has taught that even the "suckers contain the diseased material of the mother plant. Unfortunately my "stay was too short to make myself absolutely certain of the real cause : in my "opinion, the whole phenomenon comes about through a parasitic mould, which "has its origin in the altered chemical relations of the soil consequent on the "existing state of cultivation. Ten years ago the pest was completely unknown, "but at the present time, has gained such strides that it becomes the serious duty "of the proprietors to have enquiry made into its origin on scientific lines".

***Richard Schomburgk,** "Travels in British Guiana, 1840-1844" translated by **W. E. Roth,** page 66, paragraph 230.

This account is extremely interesting. In the preceding paragraphs, Schomburgk has distinguished between the plantain (*Musa paradisiaca*) and the banana (*Musa sapientum*), but at the beginning of his description of this disease he refers to it as attacking the *Musa* plantations, from which we may assume that both plantains and bananas were affected. The use of the term 'Worm' disease suggests that some of the wilting at any rate was either due to, or aggravated by, the attacks of borers, which are responsible for a certain amount of wilting at the present time. The description of the symptoms of the disease, however, immediately identifies it with the wilt disease that is known to-day, and suggests its close relationship to Moko Disease. The tentative suggestions as to the cause of the disease at the conclusion of Schomburgk's description are especially noteworthy in the light of modern research and the opinions of present-day pathologists.

No reference to "Plantain Disease", as the wilting of plantains (and bananas) is generally called, appears in the Department's record till 1909, where it is mentioned by Stockdale as having been known for a long time and as being apparently more prevalent in wet years. It is reported as occurring in Wakenaam and other districts. In 1915, Bancroft refers to the disease again, and ascribes to it a bacterial origin.

More recently (1924-1926) Altson described the Plantain Disease, and, from the similarity of the symptoms, considered it to be identical with the Moko Disease of plantains and bananas, which occurs in Trinidad, and is due to that widespread parasite, *Bacterium solanacearum*. In 1927 Altson isolated a bacterium from diseased plants of Cayenne banana (Gros Michel), Dwarf banana, White plantain (Maiden) and Giant plantain (Horse), which was sent to Kew for identification. Unfortunately the cultures did not survive the journey and were dead on arrival, but from their form and the microspic appearance of the organism they were considered by Ashby* to be *B. solanacearum* E. F. Sm.

In 1929, Dr. Wardlaw, Banana Pathologist of the Imperial College of Tropical Agriculture visited the Colony in the course of a general tour of banana growing areas, in which he was searching for Panama disease. While in the Colony he examined many cases of wilt, and subsequently, together with the writer, attempted to obtain the causal organism in culture.

The most interesting result of these cultural experiments at the time, was the isolation, both by the writer and Dr. Wardlaw independently, of '*Fusarium cubense*' E. F. Sm., the causal organism of Panama Disease. Two different strains of this fungus were isolated by both workers from suckers of plantains affected by Wilt Disease, and subsequently (in 1930) *F. cubense* was isolated by the writer from diseased suckers of Cayenne banana (which is considered to be the same as

*S. F. Ashby, B.Sc., "The Bacterial Wilt of Plantains and Bananas" Agric. Jnl., of B.G., p. 217, 1928.

Gros Michel). Despite several attempts being made, however, in no case was *B. solanacearum* isolated from diseased suckers, though a number of other bacteria were obtained.

It may be mentioned here that inoculation experiments on suckers of plantains and bananas grown in tubs were carried out, both with strains of *F. cubense* isolated locally, and with others sent by Dr. Wardlaw, and also with bacteria isolated from diseased plants. In every case negative results were obtained.

Recently Messrs. Sanderson and Dunlap, representatives of the United Fruit Company, have visited the Colony to view the possibility of establishing a banana trade. They have made extensive tours of the banana growing districts, and from the symptoms of the plants seen, considered the majority of cases of wilt to be due to Moko Disease. In the course of one visit, when accompanied by the writer, a portion of the stalk of a shrivelled fruit bunch from a wilted plantain was removed by him for further observation. After a short time, the cut ends of the stalk showed the droplets of greyish white bacterial ooze considered typical of infection by *B. solanacearum*, and subsequent isolations made from the same material gave rise to wet colonies on potato plugs, which latter were rapidly turned brown and black, characteristic reactions of *B. solanacearum*. The sum total of the evidence points, therefore, to the presence of Moko Disease in this Colony, and the symptoms of the disease have been observed on Cayenne (Gros Michel), Giant Fig (Lacatan), Lady's Finger and Dwarf bananas, and on Maiden (White) and Horse (Giant) plantains. It appears, however, that wilting may be caused, or at least aggravated, by a number of factors, and that suckers of diseased plants contain a number of secondary organisms which tend to mask the true parasite.

The symptoms of the disease vary somewhat in different cases, but there are certain similar features throughout. In affected plants the outer leaves all hang down, brown and shrivelled, beside the pseudostem, while the crown of younger leaves remains green. This appearance may be found in plants affected to a partial degree by Moko Disease, and which show discoloration of the vasculars on cutting open, but may also be found in plants which are suffering from poor cultivation in a heavy soil, particularly after a spell of dry weather. The intermediate stage of yellowed leaves which occurs in Panama Disease is, however, usually absent, though it may sometimes be seen in plants attacked by borers.

In cases where diseased plants bear bunches of fruit, the fingers are stunted and undeveloped and tend to become blackened. Finally, in the ultimate stage of the disease, the crown itself wilts and collapses and the whole plant dies. If suckers of diseased plants be cut down, they show a discoloration of the vasculars varying from reddish-brown to yellow. In fruiting plants this discoloration may be traced up the stem to the fruit stalk and into the fingers.

The infectious nature of the disease may be inferred from the fact that it often occurs in patches, starting with one plant and spreading to others. The effect of environment, however, must also be considered, and it is often to be noticed that wilted plants occur on poorly drained or badly cultivated soil, often of a highly acid nature, When lifted, suckers show a very poor and stunted development of the roots. After an interval, a stool in which all plants have died, may give rise to one or two healthy suckers. In such cases, however, it is possible that the parasite, formerly present, may have died out on the site concerned.

What part may be played by *Fusarium cubense* in the occurrence of these wilts it less certain. Possibly it may act in co-operation with bacterial infection or may aggravate the wilting of the plants already weakened by the conditions under which they are growing. Since it is only from occasional samples of diseased suckers that the fungus is isolated, it may be inferred that the local strains of *F. cubense* are not widespread, and that they are not so virulent as those responsible for the ravages of Panama Disease in other countries.

Other Diseases of Plantains and Bananas.

A number of leaf spots and fruit spots of a minor nature occur, which will not be dealt with here. Anthracnose of ripening fruits, due to *Gloeosporium Musarum* Cooke et Mass. is of common occurrence. Recently, however, the writer's attention was drawn for the first time to a disease, which though of minor import, has apparently not been described as occurring in the Colony before. The disease in question, which was found affecting one or two clumps of bananas on a farm on the West Bank, Demerara, was called by the farmer 'big foot', and was said to occur in isolated cases in the neighbourhood. The symptoms of the disease are the appearance of brown and rotted areas in the pseudostem, which shrinks, causing the 'Bulb' to appear unduly large in proportion, whence the disease derives its name. Eventually the pseudostem collapses, but subsequently, the writer was informed, the same stool may give rise to healthy suckers.

It is of interest to note that on describing this disease shortly afterwards to Mr. Dunlap of the U. F. Coy., he at once recognised it as similar to a disease occurring in Jamaica and other banana growing countries in this part of the world, and known variously as 'Bigge Foote,' 'Elephantiasis' and 'Pineapple disease' (from the associated odour). Owing to its minor nature, it has never been the subject of any very detailed investigation, but such attempts as have been made have failed to discover any causative organism.

TOMATO CULTIVATION.

BY

E. M. PETERKIN,

Agricultural Superintendent.

INTRODUCTION.

With a view to testing the possibilities of tomato cultivation on the sand reef soils of the Colony, comparative trials have been undertaken at Cecilia, East Coast, Demerara, with seed obtained from Messrs. Peter Henderson, New York; Hastings, Atlanta, U.S.A.; and Sutton and Sons, Reading, England.

These experiments were first started in 1928 and have been continued with fresh imported seed each succeeding year. As a result proved seed and seedlings have been distributed when available. Since 1932 every farmer who visited Cecilia has been given a couple of ripe tomatoes as a small source of seed for trial. As a further incentive, seedlings raised from freshly imported seed and seed obtained from dried fruit were distributed free. The following indicates the total quantity distributed each year.

TABLE I.

Year	Ripe fruit Distributed	Seedlings	Seed
	Lbs.	No.	ozs.
1931	300	900	
1932	250	3000	48
1933	650	2000	15
1934 (to date)	175	8000	3

Efforts have been made to establish small plots of different varieties in the villages, but it is only of late that more interest is being evinced. Field days for farmers have been held at Cecilia since 1930 when different methods of staking the plants have been demonstrated, the control of insect pests and diseases explained and instructions given as to proper spacing and pruning. Besides this, special attention and advice have been given to farmers growing tomatoes in the villages.

EXPERIMENTAL WORK.

Among the varieties tested are Crimson Cushion, Ponderosa, Golden Ponderosa, June Pink, Beauty, Brimmer and Marglobe from the United States; Princess of Wales, Best of all, Golden Queen, Early Market, Maincrop and Tenderloin from the United Kingdom: Bonny Best and John Baer from Canada and Bermuda.

Trials conducted with these varieties at the Georgetown Experiment Station have met with little success as the soil—a heavy clay—is unsuited to their cultivation and, in addition, all varieties suffered badly from mosaic and blossom-end rot. However, tomatoes grown at Cecilia, gave ample demonstration of what can be achieved on the sand-reefs. The analysis of the soil at Cecilia shows it to be a highly saline light loam of alkaline reaction and is typical of the sand reefs

which occur in the undrained frontland pastures. Since tomatoes do well on this soil they should be even more successful on the better drained sand reefs further inland.

Experiments carried out up to 1931 showed that the best of the large or luxury type is the Crimson Cushion; as the demand for this type is limited, attention was concentrated on the smaller and more economic varieties. The following tables indicate the results obtained during 1932 and 1933.

1932

Country of Origin.	Variety.	Date Sown.	Date Transplanted.	Reaping period.	No. of Stems.	Area planted. Sq. feet.	Yield per plot. Lbs.	Yield per acre. Lbs.	Prevalence of Blossom-end rot.	Prevalence of Mosaic.
U.K.	Tenderloin ...	23.11.31	21.12.31	16.2.32 30.6.32	2	512	108	9,188	Very bad..	Nil
U.K.	Early Market ...	23.11.31	22.12.31	26.2.32 8.7.32	2	563	191	14,423	Very slight	Nil
U.K.	Beauty ..	23.11.31	22.12.31	24.2.32 30.6.32	2	512	100	8,503	Very bad...	Nil
U.K.	Golden Queen ...	23.11.31	17.12.31	27.2.32 21.5.32	2	308	79	11,172	Slight ...	Nil
U.S.A.	Marglobe ...	23.11.31	17.12.31	18.2.32 16.5.32	1	615	35	2,472	Very bad...	Nil
Canada	Marglobe ...	23.11.31	17.12.31	18.2.32 8.7.32	2	615	164	11,616	Very bad...	Nil
U.S.A.	Crimson Cushion	23.11.31	22.12.31	26.2.32 16.5.32	2	750	99	5,768	Bad ..	Nil

1933

Country of Origin	Variety	Date Sown	Date Transplanted	Reaping Period	No. of Stems	Area Sq. ft.	Yield per plot lbs.	Yield per acre lbs.	Prevalence of Blossom-end rot	Prevalence of Mosaic
				Imported Seed						
U.K. ..	Early Market ..	24.4.33	23.5.33	5.8.33 to 7.9.33	2	720	52	3,146	Nil	Slight
Canada...	Bonny Best ...	1.5.33	7.6.33	23.8.33 to 28.9.33	2	480	32	2 904	Nil	Slight
Canada...	John Baer ...	1.5.33	7.6.33	23.8.33 to 28.9.33	2	480	14	1 270	Nil	Slight
U.S.A. ..	Marglobe ...	24.4.33	23.5.33	5.8.33 to 7.9.33	2	480	29	2,631	Nil	Slight
U.S.A. ...	Bonny Best ...	1.5.33	7.6.33	12.8.33 to 28.9.33	2	480	19	1,724	Nil	Slight
	Seed collected at Cecilia from imported varieties									
U.K.	Early Market ...	24.4.33	23.5.33	5.8.33 to 7.9.33	2	240	14	2 540	Nil	Very bad
U.S.A. ...	Marglobe ...	24.4.33	25.5.33	8.8.33 to 7.9.33	2	240	10	1,815	Nil	Very bad

From this it will be seen that the Early Market variety is the best all-round tomato tried yet and the Department can recommend it with confidence; it not only gives the heaviest yield but is the most resistant to mosaic and blossom-end rot.

The experiments carried out tend to show that imported seed gives better returns than seed collected from fruit grown locally. Further trials with this will be carried out in 1934.

Marketing.

The best results are obtained by sowing in November, the crop being reaped from February onwards. The ideal time to sow for export would be with the May-June rainy season and to export for the late Autumn and early Winter markets, but the long dry season following the short rainy one and the difficulties of irrigation prevent this.

An export industry cannot be envisaged without cooling and storage plants, grading and packing warehouses, etc. Another point which is usually overlooked and is rarely appreciated by the average farmer is the importance of uniformity of size, shape, colour and ripeness of fruit and the shape and type of the crate in which fruit is packed for export.

A further difficulty from the point of view of an export trade is the scattered distribution of the soils suitable for tomato cultivation, many areas being at considerable distance from intermediate transport points and port of shipment. Not only would this greatly add to the cost of collection and packing, but the fruit would tend to deteriorate each time it was handled.

The local demand, however, has not yet been met or developed, and is a local industry well worthy of more attention by the farmers, especially those who are suitably situated and within easy reach of Georgetown.

Hints on Cultivation.

The soils best suited to tomato cultivation are the sand reefs and adjoining loams. An adequate water supply is essential during the dry season.

Seed.—The advice of the District Agricultural Officer should be asked as to the variety to be grown. The seed should be sown thinly in a well-prepared seed bed or box if preferred. The seedlings should be transplanted at about 4 to 5 weeks old in thoroughly prepared beds, entirely free from weeds; the beds should be 4 feet wide, the seedlings spaced 2 feet apart in the rows and 3 feet between the rows and staked at 18 inches high.

Pruning.—As soon as the young plants begin to branch, all of the young shoots should be picked off except the strongest at the base of the plant, which should be allowed to remain to form a second stem. This should be carefully watched as it does not pay to grow more than two stems: this operation controls both the quality of the fruit and the yield in weight.

If the weather is dry it would pay to mulch the beds with dry rice straw or another similar material handy ; this conserves the moisture and saves labour watering.

A careful watch should be kept for mosaic disease. This is easily spotted by a mottling and curling of the leaves : all plants attacked by this disease should be destroyed, as mosaic is very virulent and is transmitted from one plant to another by the mere process of handling. Caterpillars must also be looked for, picked off and destroyed.

When the fruit begins to develop, any fruit observed with a black scar should be picked off ; this is known as blossom-end rot. The fruit is not saleable if allowed to develop and it is wiser to pick them off at an early stage.

The fruit should be picked just before they commence to turn and carefully packed, firmly, but not too tightly ; if packed loosely considerable bruising will occur.

ACKNOWLEDGMENT.

The writer wishes to express appreciation of the assistance given by Mr. C. C. Dowding, Agricultural Instructor, in the conducting of these trials.

EMERGENCY AGRICULTURAL LOAN, POMEROON RIVER.

BY

A. de K. FRAMPTON, C.D.A.,
Agricultural Superintendent, Essequibo.

An Emergency Agricultural Loan for the Pomeroon farmers who had suffered losses from the floods was sanctioned by Government during April.

The circumstances which led to the loan being granted were as follows :—

Exceptionally heavy rains were experienced during November and December and early January in the Pomeroon River District, culminating in the downpour of January 6 and 7, 1934. The river rose two feet on the morning of January 7 between 7 a.m. and 9 a.m. and continued to rise throughout the day. The district had been mildly flooded since January 5 when there were 12 inches of water at Charity. All the soils of the coffee grants had been saturated for some days, but surface water was drained off on the low tides up to the night of 6th January. With the rainstorm of January 6-7 and the rising of the river, drainage was impossible, andall the cultivations became flooded. These conditions were aggravated by the breaching of the dams, made soft and porous by the continuous rains, and savannah water poured over into the grants from the Akawinni Creek Savannah which is situated at the back of the grants on the left bank of the river. Flood conditions were such at this time, that the water from the grants on the left bank of the river overflowed the dams in front of the grants and the river rose to such a height that the cultivations on the right bank of the river were flooded by water pouring over their front empolder dams. Fortunately the grants on the right bank were not flooded from the savannahs at the back, or conditions would have been much worse. Above Charity the grants on the right bank were saved from worse flooding (from Tapacooma Savannah), by the new dredge canal and dam which had recently been completed. Had it not been for this canal and dam the overflow from the Tapacooma Savannahs would have washed right through these grants.

The river remained very high for some time and did not stop flowing for $3\frac{1}{2}$ days. Flood conditions were general throughout the river for 14 days. Some grants were flooded for 21 days.

Flood conditions were worst on the left bank of the river above Charity ; below, the worst conditions were found on the right bank.

After 3 days the water at Charity dropped at the rate of 1 in. to 3 ins. per day.

Conditions on the grants were very bad during the flood period. Water varied in depth from 3 to 4 ft. and in some cases the floors of the houses were under water. Provision cultivation was ruined, all root crops started to rot, and cassava, etc. was being given away to any person who could go and dig it. It was impossible to do any work on the large grants, and casual labourers, who have small provision holdings and work as labourers on the large grants, were faced with starvation, as all their provision crops were ruined.

Stored prepared coffee, and pulped beans stored for hulling, were all destroyed by the flood water. Copra was ruined, and many thousands of shelled coconuts were washed into the river and lost. When the flood water had subsided all grant-holders were faced with a very serious position, not only had they lost practically all their provision crops and stored produce such as coffee, etc., but they were faced with heavy expenses for repairs to their empolder dams, drains and kokers. The small holders had lost all their food crops, but fortunately, the Flood Relief Committee came to their assistance with grants of food, clothing, and blankets. Further disaster affected the coffee farmers. As soon as the flood water subsided, coffee and fruit trees started to die in large numbers. Petitions for financial assistance were forwarded to His Excellency the Governor to assist the coffee farmers, who, apart from expenses incurred in connection with repairs to their empolder dams, were now faced with the much more serious problem of the loss of their permanent cultivation from which they derived their living.

His Excellency the Governor visited the Pomeroon River area on February 4 & 5, and received a deputation of farmers. On His Excellency's instructions a report was made by the writer who visited the river and inspected some of the coffee grants. On February 21 the Honourable the Colonial Secretary, chairman of the Flood Relief Commission arrived on the coast accompanied by the Director of Agriculture and Director of Public Works. The Pomeroon River was visited on February 22 and several damaged coffee cultivations were inspected. At this time coffee trees were dying extensively throughout the river. At first disease was suspected, and on April 6 the writer accompanied the Mycologist on a visit to the river. No trace of disease was found, but it was discovered that the trees were dying from the effects of the hot sun after a prolonged period of water-logging and flooding. It was noticeably worst on those grants where clean weeding had been carried out and farmers were advised to mulch with trash and grass around the coffee trees to keep the soil as cool as possible. This checked the mortality to a certain extent, but trees are still dying up to the present date and it is thought that the only thing to stop this will be the commencement of the May—June rains.

Representations were made to Government by the District Commissioner on the writer's report and an Emergency Loan was granted, the terms of which are as follows :—

Purposes :—

(*a*) To provide advances for the maintenace of labour to carry out ground provision cultivation on lands on which crops have been destroyed by floods.

(*b*) To provide advances for the maintenance of labour to carry out coffee cultivation on lands where this has been destroyed by floods.

(*c*) To assist in empoldering lands for immediate cultivation and improvement of the drainage and irrigation systems to faciliate all lands available for cultivation being planted this season.

(*d*) To encourage labour generally to take up lands for cultivation of general agricultural crops.

Such loans will only be granted on a basis approved by the District Commissioner and Agricultural Superintendent, Essequibo, who must be satisfied that the grant-holders are taking steps to re-establish their cultivations.

i. All applications for loans should be forwarded to the District Commissioner, Essequibo.

ii. Advances will only be made in respect of lands inspected and certified by an Agricultural Officer to have been brought into cultivable condition.

iii. All loans granted will be made and recovered through the Henrietta Co-Operative Credit Bank, Essequibo.

iv. No loans will be made after 30th June, 1934.

v. The rate of interest shall be at the rate of 6 per centum per annum from the date the loan is made.

vi. Loans granted in respect of (*a*) shall be repayable in full at the time of harvesting the crop, while loans granted in respect of (*b*), (*c*) and (*d*) shall be repayable over a period of five years.

vii. Security of repayment of loans : Each borrower will be required to have at least two sureties for all loans obtained. The sureties must sign the necessary promissory note along with the borrower.

Application forms were distributed to farmers requiring financial assistance, and the writer who is chairman of the Henrietta Loan Bank accompanied by the Secretary of the Bank has carried out visits of inspection on various grants in the river. A sum of two thousand dollars was at first granted by Government loaning to farmers, representations have been made to Government to allow a further sum to be loaned. The farmers on the Pomeroon have borne their losses with great fortitude and are trying their best to rehabilitate their cultivation with the

financial assistance rendered by Government. Many of the farmers have to make a completely new start, having lost all their coffee trees, which they have taken years to bring to perfection. In times when coffee prices were good, the coffee cultivation in the Pomeroon River was only on a small scale. All the profits made in those years were spent on improving their grants, putting down machinery, and extending their cultivations. Not only have these farmers now lost their crop (very little coffee could be made with the last picking) but they have lost the trees which bore it and their capital expenditure over the past 10-15 years has been lost also.

The coffee cultivation in the Pomeroon River extends from Siriki, approximately 7 miles above Charity to Enterprise, approximately 12 miles down the river, on both banks. The total area is 470 acres, and in 1932 produced 2,488 cwts. of coffee.

It is estimated that at least 30% of the coffee cultivation has been destroyed and at least 50% of the crop lost.

SEASONAL HINTS.

Agricultural—*July* :—The planting of general agricultural crops such as rice, plantains, cassava, eddoes, yams, peas, beans, melons, cucumbers, squash, ochroes and spinach, which were delayed by rains, should now be completed as early as possible. Transplant the following seedlings :—boulangers, tomatoes, peppers and cabbages. Look for bud-worms on cabbages. Do not over-water tomatoes. Drains should be dug and kept free from weeds. On old land that will not be required for several months or on new land that is not in good physical condition, it is advisable to sow a leguminous green manure crop to improve the fertility. Lima beans, bonavist, cow-peas and black-eye peas are suitable ; these are useful as a food crop and in addition serve the purpose of a green manure.

August :—The weather will be getting hot and most crops will require watering. Weed and mould sweet potatoes ; mulching should be done. Stake tomatoes with a strong bamboo and grow two stems only ; pinch off side-laterals from these stems but do not remove any leaves ; if mosiac appears on tomatoes, destroy plants. Pull out weeds from rice plots. Plant lettuce, radishes, eschallots, yard beans. Tannias should be planted so as to mature before cockles invade them.

September :—Dry period. Hoe weeding should be done to conserve moisture where no mulching has been applied. Keep all beans well picked to prolong cropping period. Thin out plantain and banana suckers. Plant radishes, eschallots and lettuce. Sow lettuce seed thinly and when big enough transplant in beds six inches each way ; this crop needs rich soil and must never suffer from want of water. Clean dry litter should be placed under and over the fruit of melons, pumpkins, etc., to prevent staining or scorching.

Horticultural.—With the onset of the mid-year rains, pruning of shrubs and trees should be carried out. Many of the common ornamental shrubs and climbers—Bougainvillæa, Queen of Flowers, Ixora, Duranta, etc. can with advantage be cut back considerably at this time of year, and will soon spring again. Pruning of roses should also receive attention.

In the wet weather, ringing and layering can best be carried out, and in the case of the former treatment, the covering of the ringed area does not need such constant attention to ensure that it remains damp.

As mango trees put out their new shoots, grafting can be proceeded with ; similarly showery weather is the best for budding citrus.

When rainfall is not too heavy and the ground not water-logged, planting out of young trees and shrubs can be seen to, and towards the end of the wet season vegetable seedlings may be set out. The season is suitable for making up lawns.

The most advantageous period of the rains to the gardener are the showery spells at the beginning and end of the wet season. The continuous rains of late June and July, when everything is water-logged, make the soil too wet and sticky to work, cause drains to fill and be choked, and bring about the damping off of seedlings and a general check to the growth of many plants. The first rains however, cause a fresh burst of growth in plants that have been held in check by the prolonged dry spell. The final showers of the wet season give vigour to plants which will blossom and fruit in the ensuing dry months.

NOTES.

Planting Distances.—The following table indicates the number of plants required to plant an acre at the several distances specified.

	Plants		Plants
3 in. x 12 in.	174,240	20 in. x 24 in. ...	13,068
6 in. x 6 in.	174,240	20 in. x 30 in. ...	10,454
6 in. x 9 in.	116,160	20 in. x 36 in. ...	8,712
6 in. x 12 in.	87,120	20 in. x 42 in. ...	7,467
9 in. x 9 in.	77,440	20 in. x 48 in. ...	6,534
9 in. x 12 in.	58,080	2 ft. x 2 ft. ...	10,890
12 in. x 12 in.	43,560	2 ft. x 3ft. ...	7,260
12 in. x 15 in.	34,848	2 ft. x 4 ft. ...	5,445
12 in. x 18 in.	29,040	2 ft. 6 in. x 3 ft. .	5,808
12 in. x 24 in.	21,780	3 ft. x 3 ft. ...	4,840
12 in. x 30 in.	17,424	3 ft. x 4 ft. ...	3,630
12 in. x 36 in.	14,520	3 ft. 6 in. x 3 ft. ...	4,148
12 in. x 42 in.	12,446	4 ft. x 5 ft. ...	2,178
12 in. x 48 in.	10,890	4 ft. x 6 ft. ...	1,815
15 in. x 18 in.	23,232	4 ft. x 8 ft. ...	1,361
15 in. x 24 in.	17,424	4 ft. x 10 ft. ...	1,089
15 in. x 30 in.	13,939	4 ft. x 12 ft. ...	907
15 in. x 36 in.	11,616	6 ft. x 6 ft. ...	1,210
15 in. x 42 in.	9,956	6 ft. x 8 ft. ...	907
15 in. x 48 in.	8,712	6 ft. x 10 ft. ...	726
18 in. x 18 in.	19,360	6 ft. x 12ft. ...	605
18 in. x 24 in.	14,520	10 ft. x 10 ft. ...	435
18 in. x 30 in.	11,616	11 ft. x 11 ft. ...	360
18 in. x 36 in.	9,680	12 ft. x 12 ft. ...	302
18 in. x 42 in.	8,297	13 ft. x 13 ft. ...	256
18 in. x 48 in.	7,260	14 ft. x 14 ft. ...	222

Jamaica Agr. Jour.

Colonial Sugar Preference.—The Preference on colonial sugar entering the United Kingdom was increased in 1932 from 3/9 per cwt. of 96° sugar to 4/9, with an additional 1/- per cwt. on a specified quota, the quota being allocated to the several Colonies on the basis of certificates. This was calculated to give assistance to the sugar-exporting Colonies without advancing the U.K. preference to a higher figure than the Canadian preference ($1.00 per 100 lbs.) as it was realised that a Canadian preference lower than that of the U.K. would result in the dislocation of sugar traffic with Canada.

This increased preference helped to give some assistance and until recently a considerable quantity of colonial sugar went to Canada. When, however, there was a fall in the exchange value of the Canadian dollar, much of the sugar which went previously to Canada was diverted to the U.K.; the importations of British West Indian raws into Canada during 1933 were 60,000 tons less than in 1932.

To circumvent this undesirable situation, the Secretary of State for the Colonies, proposed the following scheme:

(1) The general preference granted to Colonial sugar to be reduced to its old rate of 3/8.8d. per cwt. on 96° sugar with proportionate rates for sugar of higher or lower polarisation (thereby making the ordinary United Kingdom preference once more less valuable than the Canadian preference, so that it will again be profitable for Colonial sugar to be sold in Canada).

(2) An additional preference at the rate of 3/- per cwt. on 96° sugar (making approximately 6/9 in all), and proportionate rates for sugar of higher or lower polarisation, to be given to a quantity of Colonial sugar limited to 360,000 tons per annum. This special preference will be administered by means of certificates issued by the Colonial Office just as the existing certificate preference of 1/- per cwt. is administered.

It is intended that the Colonies should enjoy the same benefit with the new preference as with the 1932 increase of preference, which is replaced. The cash benefit provided by the new quota preference of 3/- per cwt. (or £3 per ton) on 360,000 tons (ignoring polarisation differences) is £1,080,000. The allocation of the new quota has been placed on a different basis from that previously in operation, the figure for British Guiana being increased from 51,100 to 60,000 tons.

There has been a quick response by the trade because despite the fact that there had been a complete cessation of sugar shipments from the West Indies to Canada after May 1933, reports show that British Guiana sugar is once again being exported to Canada.—H. D. H.

Tobacco-Topping and Suckering.—The main object of topping and suckering tobacco is to hasten maturity. These practices are also important factors in the production of quality leaf.

The natural thing for the tobacco plant to do is to set seed, but by removing the flower head (*i.e.*, topping) as soon as it appears, seed setting is prevented and much of the plant-food material that would have been used up in seed formation will be made available for leaf development. Tobacco plants that are allowed to go to seed or produce suckers have thin papery leaves of poor texture, body and weight.

Topping results in lateral shoots soon making their appearance at the leaf axils and at the base of the plant. Naturally, if these are not removed they also will develop and set seed heads at the expense of the tobacco leaves.

To determine at what height the plants should be broken off, it is essential that the vigour of the plant be first carefully observed, and the earliness or lateness of the season should also be taken into account. Then, too, the question of obtaining uniformity in ripening over a fair area of the crop to facilitate an even and sufficient picking for flue-curing must be considered.

With well-grown and early light and bright types of tobacco it is usual to leave about fourteen or fifteen leaves to come to maturity. With late tobacco it is often advisable to leave only nine or ten leaves, excluding the damaged bottom leaves.

Many growers do not fully realise the damage they are doing to their crop in allowing suckers to grow too large. Suckers should be removed as soon as they can be conveniently grasped in the fingers and not permitted to grow longer than 2 inches.—*Queensland Agricultural Journal, March, 1934.*

The Flood Investigation Committee.—The report of this Committee has been published as Legislative Council Paper No. 6/1934, and gives a concise account of the flood conditions, its causes and effects. The loss to the sugar industry is summarised below.

Total sugar lost	20,172 tons	
Loss in manure, livestock, dams, extra pumping		$ 71,910
Re-establishment and re-habilitation ...		104,255
		$176,165

Only sugar estimated lost in 1934 has been included, except in special instances where it otherwise appeared fair and reasonable. In no case has a charge for manure already applied been allowed as this loss is included in estimated sugar losses in the field. Allowances of not more than $12-$15 per acre for re-establishing fields of plant canes and $4-$5 per acre for ratoons have been admitted.

Investigation showed that in so far as the villages and smaller estates were concerned, the principal damage caused by the floods was the destruction of ground provisions, together with large numbers of fruit trees such as avocado pears, bread-fruit, plantains and bananas. Coconut plantations, except in the case of young trees, did not suffer much damage.

All possible assistance was rendered by the Department of Agriculture. .ng material of quick-growing food crops was telegraphed for and was

received with the minimum delay, and, together with supplies of cuttings and suckers purchased locally (chiefly in the North West District) was distributed in those areas where the loss was heaviest. Substantial money prizes are being awarded for quick re-establishment and extension of the ground provision areas.

Large numbers of cattle, horses, mules, donkeys, pigs, sheep, goats and poultry were destroyed.

Of the districts in which the cultivation of coffee is a major industry, the Pomeroon suffered considerable damage. Whereas some of the older trees survived, large numbers of young trees were entirely destroyed.

The early rains of October and November followed by the heavy rains in December affected many acres of padi, which it was impossible either to reap or place under cover before it was destroyed. Many bags of padi also were damaged due to the flooding of rice mills.

An estimate based on the total production figures of 1932, with an allowance for flood losses of 30 per cent. gives a figure of roughly 18,000 tons of rice available for export from existing stocks. Unfortunately, much seed padi has been lost and in this connection also, the Department of Agriculture is rendering all possible assistance, a special vote being allowed for the provision of seed padi to farmers.

In regard to the distribution of planting material in flood-damaged areas, the figures below show the supplies that have been obtained by the Department of Agriculture from the North West District and distributed. In addition, supplies of planting material have been imported and collected from different parts of the Colony and transferred by the Department's agency to flood-areas as demands have arisen.

Planting material collected in the North West District and distributed by the Department of Agriculture to flood damaged areas.

DATES RECEIVED

	Feb. 9	Feb. 23	Mar. 9	Mar. 23	Apl. 4	May 4	May 18
Eddoes (bags) ...	35	18	35	...	6	38	7
Tannias ,, ...	30	4	4	...	6	29	40
Tannia bottoms (bags) ...	25	10	30	...	...	12	8
Yams (bags) ...	5	...	5	...	...	19	...
Sweet Potatoes (bags) ...	...	6	1	...	...	1	...
Sweet Cassava Sticks (bundles) ...	45	44	38	13	25	54	22
Bitter Cassava Sticks (bundles) ...	22	81	62	...	25	21	...

DEPARTMENTAL NEWS.

The Department of Agriculture on behalf of the agricultural community of British Guiana offers it congratulations to Sir Crawford Douglas-Jones, Kt., C.M.G., and Sir Edward Davson, Bart., K.C.M.G., on the honours bestowed at the hands of His Majesty the King and announced recently in His Majesty's Birthday Honours. Sir Crawford as Colonial Secretary of British Guiana has always closely identified himself with the agricultural development of the Colony. Sir Edward as a principal of one of the most important sugar and commercial firms of the Colony has taken an active part in Empire matters on the whole and those of British Guiana in particular.

Professor the Honourable J. Sydney Dash, Director of Agriculture, left the Colony for Canada on vacational leave on May 1, 1934. Hon. F. Burnett has been appointed Director of Agriculture (Acting) and, in addition, a member of the Legislative Council as from that date.

Mr. C. Cameron, Field Manager of the Sophia Sugar Experiment Station, was granted six months' leave of absence to take a special course of study at the Imperial College of Tropical Agriculture, Trinidad.

It has been announced that Hon. G. E. Anderson, Managing Director of Pln. Diamond, has resigned his post prior to retirement. Mr. Anderson has been one of the oldest and most valued members of the Sugar Experiment Stations' Committee. Not only has Mr. Anderson served on this Committee, but was Chairman from May, 1926 to March, 1927. The Department wishes to express its keen appreciation of the time, attention and help given for many years to the experimental work of the sugar industry of the Colony.

Mr. H. G. Seaford, prior to leaving for England on furlough, resigned his post as Chairman of the British Guiana Rice Marketing Board and President of the Rice Association. Many references were made to the valuable service which had been given to the rice industry by Mr. Seaford and much of the success of the operation of the Board and of the Association were attributed to Mr. Seaford's energy and leadership. Mr. F. H. Martin-Sperry has been elected President of the Association *vice* Mr. Seaford and Mr. C. W. Shankland, Chairman of the Board.

Mr. V. C. Dunlap of the United Fruit Company arrived in the Colony on April 22 to make a special study, in co-operation with the Department of Agriculture, of the soils of the colony in special reference to banana-growing. Mr. N. E. Sanderson, a representative of the same Company arrived on May 5 also to investigate the banana possibilities in conjunction with Mr. Dunlap.

Hon. F. Burnett, Director of Agriculture (Ag.), has recently made several tours of inspection in different parts of the country and has accompanied the representatives of the United Fruit Company on visits to the Demerara River and East Coast agricultural areas.

His Excellency the Governor has been pleased to approve of the following departmental promotions, subject to the sanction of the Secretary of State for the Colonies :—

Mr. H. D. Huggins, M.Sc., Dip. Agr., Assistant Agricultural Superintendent to be Agricultural Superintendent ;

Mr. E. G. Benson, B.Sc., Dip. Agr., A.I.C.T.A., Rice Grading Inspector, to be Assistant Agricultural Superintendent ;

Mr. H. E. H. Gadd, Secretary of the B.G. Rice Marketing Board to be Rice Grading Inspector ;

Mr. L. E. McKinnon, Agricultural Foreman, to be Agricultural Instructor.

Mr. F. A. Squire, Supernumerary Entomologist, left the colony from May 7 to June 13 for Trinidad on sick leave.

Mr. J. D. Gillespie, Agricultural Superintendent, with his bride, returned to the colony from Scotland, after six months' leave of absence, on May 17, 1934. Mr. Gillespie is now stationed in Berbice in place of Mr. H. Macluskie, Agricultural Superintendent, Berbice, who left the colony on June 1, on six months' leave of absence.

Mr. E. B. Martyn, Botanist and Mycologist, left for England, on June 13, on 4 months' vacational leave.

Mr. C. H. B. Williams, Agronomist-in-charge, Sugar Experiment Stations, who was granted study leave to pursue a post graduate course in Plant Breeding at Harvard University, returned to the Colony on June 26. Mr. Williams has fulfilled the requirements necessary for the Degree of M.A. of the University.

PLANT AND SEED INTRODUCTION

The following are recent introductions by the Department of Agriculture.

Name	Quantity	Whence Supplied
Economic		
Aleurites montana (Tung Oil)	1 parcel seed	Royal Botanic Gardens, Kew.
Grapefruit—Budded "Marsh"	800 plants	Agricultural Department, Trinidad.
Orange—Budded		
"Parson Brown"	50 ,,	do.
"Valencia"	50 ,,	do.
"Jaffa"	50 ,,	do.
"St. Michael"	50 ,,	do.
Sweet Corn Seed	1 packet	Agr. Expt. Stn., Puerto Rico.
Pineapple—"Abacaxi"	4 parcels planting material	Brazil.
Hybrid	5 suckers	Hawaii.
Padi—23 Varieties	4 parcels	Egypt, India, Africa and Br. North Borneo.
Vegetable seeds (asstd.)	72 packets	Messrs. Sutton & Sons, England.
do.	3 lbs.6 oz.	
do.	50 lbs. 7 oz.	Messrs. Peter Henderson & Co., U.S.A.
Sesbania aegyptiaca	2½ ounces	Imp. College Trop. Agr., Trinidad.
Tomato—3 Varieties	9½ ounces	Messrs. Wm. Ewing & Co., Canada.
Lespedeza—		
L. sericea		
Korean lespedeza	4 ounces ea.	U.S. Department of Agriculture, Washington.
Robe do.		
Common do.		
Yams Plants—7 Varieties	35 lbs.	Imp. College of Trop. Agr., Trinidad.
Onion Seed—		
"Red Bombay"		
"Red Madras"	1 ounce ea.	Agricultural Department, Montserrat.
"Eschalotte"		
Pueraria thunbergiana (Kudzu)	1 lb.	U.S. Department of Agriculture, Washington.
Popondo—P. 3	1 packet	Nigeria.
Cauliflower—"Benares Main crop	2 ounces	Royal Seed House, Calcutta, India.
Ornamental		
Lily—Pink Anthurium	1 plant	Trinidad.
Orchids—		
Dendrobium Macarthiae		Heneratgoda
Oncidium multiflorum	13 plants	Botanic Gardens,
Vanda spathulata		Ceylon.

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the Agricultural and Forest Products of the Colony exported for the first three months during 1934.

The corresponding figures for the same period during previous years and the average for the sixteen years prior to that are added for convenience of comparison.

Product		*Average 1916-31*	*1932*	*1933*	*1934*
Sugar	tons	18,616	29,099	40,464	36,796
Rum	proof gallons	379,101	137,251	269,601	155,651
Molasses	gallons	808,300	1,443,345	1,982,394	1,570,859
Molascuit	tons	302	nil	52	nil
Rice	tons	4,789	8,141	7,582	6,445
Coconuts	thousands	306	379	151	293
Coconut Oil	gallons	6,490	6,200	3,539	3,621
Copra	tons	765	290	352	100
Coffee	tons	111	100	196	140
Lime Juice Concentrated	gallons	158	nil	nil	not yet available
Essential Oil of Limes	gallons	7	127	138	not yet available
Rubber	tons	2	nil	nil	nil
Balata	tons	81	112	183	38
Gums	tons	0.1	0.2	nil	nil
Firewood—Wallaba, etc.	tons	2,434	3,182	3,839	3,819
Charcoal	tons*	745	989	897	927
Railway sleepers	No.	4,079	1,550	300	3,567
Shingles	thousands	497	349	151	197
Lumber	ft.	50,597	65,899	45,636	30,125
Timber	cu. ft.	47,546	13,671	56,645	51,570
Cattle	Head	191	17	1	113
Hides	No.	1,690	952	1,592	1,815
Pigs	No.	117	188	82	53
Sheep	No.	3	23	nil	nil

*18 bags to ton

CURRENT PRICES OF COLONIAL PRODUCE.

From The Commercial Review, Journal of the Georgetown Chamber of Commerce, Vol. XVII, No. 11, May, 1934.

SUGAR.

Per 100 lbs. net   3 lbs. per Bag allowed for tare

Dark Crystals for Local Consumption.......................$3.30
Yellow Crystals do. do. $4.00
White Crystals..$4.75
Molasses Sugar..none offering

RUM.

Imperial Gallon.   Cask included.

Coloured, in Puncheons—40 to 42 O.P...(for export)...50c. Hhds. 76c. Barrels 77c.
White, in Hogsheads—10 to 45 O.P...(for local consumption)...............45 to 55c.

MOLASSES.

Per Imperial Gallon.   Naked.

Yellow (firsts)..10c.
Yellow (seconds)..5½c.
Dark..2½c.

RICE.

Rice...............per Bag of 180 lbs. gross, Brown Super $4.00 to $4.50. White $2.75 to $3.50 as to quality. Lower Grades $3.00 as to quality.
Paddy ....per Bag of 143 lbs gross, $1.00 to $1.50 as to quality. New Crop.

GENERAL.

Timber, Greenheart, (Lower grade measurements)...40c. to 60c. per c. ft.
for export 72c. to $1.00 per c. ft.
do. Railroad Sleepers—(Mora)..............................$1.68 each.
Greenheart Lumber....................................$60 to $70 per 1,000 feet.
Crabwood Lumber.....................................$60 to $75 per 1,000 feet.
Shingles, Wallaba, 4 x 20 and 5 x 22 inches, ...$3.50 to $5.50 per M.
Charcoal, Capped for shipment ....72c. to 85c. per bag.
Firewood..$2.16 to $2.50 per ton.
Coconuts...Selects, $9.00, culls...$6.00 M...Copra $1.25 per 100 lbs.—Prime Copra.
Balata.......................Venezuelan, none. Local Sheet...36 to 38 cts. per lb.
Cocoa...14 to 16 cts. ,, ,,
Coffee...7c. to 8 cts. ,, ,,

N.B.—Duty on Payable value at time of Importation and rate of exchange on day of arrival.

METEOROLOGICAL DATA—JANUARY—MARCH, 1934.

Recording Stations & Months.	Rain-fall. Total Inches.	NUMBER OF DAYS OF RAIN: Under ·10 Inch	·10 to ·50 Inch	·50 to 1·00 Inch	1·00 Inch to 2.00 Inches	Above 2.00 Inches	Total days.	Evaporation Inches	Air Temperature and Humidity. Maximum.	Minimum.	Mean.	Humidity Mean.
Botanic Gardens.												
January ...	28·00	5	10	3	7	3	28	2·89	81·7	73·8	77·7	86·8
February ...	2·39	4	8	1	...	...	13	4·82	82·6	74·3	78·7	79·2
March ...	3·51	7	6	1	1	...	15	5·96	82·9	74·8	78·8	76·6
Totals	33·90	16	24	5	8	3	56	13·67				
Means.	...	...	...	...	...	...	...	...	82·4	74·3	78·3	80·9
Berbice Gardens.												
January ...	10·96	...	9	3	2	1	15	...	88·9	67·5	78·2	84·6
February ...	1·62	1	3	1	...	...	5	...	88·6	69·0	78·8	74·0
March ...	4·02	3	5	3	1	...	12	...	88·9	72·9	80·9	79·8
Totals	16·60	4	17	7	3	1	32	...				
Means.	...	...	...	...	...	...	...	...	88·8	69·8	79·3	79·5
Onderneeming												
January ...	24·12	...	8	5	7	3	23	...	88·3	72·9	80·6	88·4
February ...	1·73	...	7	...	...	...	7	...	88·7	73·2	80.9	87·6
March ...	3·11	1	4	1	1	...	7	..	88·6	73·2	80·9	88·1
Totals	28·96	1	19	6	8	3	37	...				
Means.			...	...	...	...	...	...	88·5	73·1	80·8	88·0
Morawhanna. N.W.D.												
January ...	10·55	5	7	4	1	2	19	...	...	...	...	
February ...	3·08	3	5	3	...	...	11	...	...	...	...	
March ...	1·83	2	6	1	...	...	9	...	...	...	...	
Totals	15·46	10	18	8	1	2	39	...	...	...	...	

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Field Assistant	B. A. McArthur
Clerical Assistant	J. B. Bourne

In collaboration with the Officers of the Department of Agriculture.

CONTENTS.

(Vol. V, No. 3.)

ORIGINAL ARTICLES.

REPORTS.

REVIEWS.

LIST OF ILLUSTRATIONS.

The
Agricultural Journal of British Guiana.
September, 1934.

EDITORIAL.

CANE EXPERIMENTATION.

If one were asked to indicate the major psychological difference between the layman and the trained scientist one would be tempted to say that the difference lay in the ability of the latter to distinguish clearly between opinions and facts.

Many laymen can and do make the distinction, while, on the other hand, some technical workers have failed to appreciate the line of demarcation, but, in general, there is a fundamental difference in outlook between the two large groups. When a sufficient number of persons has expressed the opinion that one thing is heavier than another, or longer than another, or sweeter than another, the mass of laymen accept the expressed opinion as fact; the scientist asks if anyone has weighed or measured or tested the sugar content of the several things under exactly parallel conditions. Until such tests have been repeatedly made with identical or very similar results the scientist feels that no fact has been proven.

In the days when soils were virgin, diseases and pests rare, methods rudimentary and competition slight, there was not that careful sifting of opinions, that rigid determination of facts which today's conditions make imperative. In the first place, when profits are large, differences of five or ten per cent. in yield are not considered important. In the second place when the first drains were dug, when the first applications of sulphate of ammonia were made, when a reasonably good variety appeared in a country where yields were low, and the local variety degenerating, when the first fields were flood fallowed, the difference made was so obvious that even the scientist could not cavil, could not but admit that the favourable opinions expressed were above question. In the third place there was but little room for detailed experimentation in a new and hardly organised industry and because of the newness of the field, both the scientist, whose training made him observant, and the practical agriculturist could frequently discern likely improvements and express opinions which time proved to be facts.

That is a description of what has been. The margin between cost of production and market quotations is now narrow, competition is keen, pests and diseases have multiplied, soils are no longer virgin, labour is dearer and less

abundant; the more obvious improvements in field practice, factory operation, irrigation, flood-fallowing, labour organisation, etc., have been effected and our yields have been raised to a figure which compares favourably with that of most sugar countries. It is now a question of deciding not whether flood-fallowing is better than grass-fallowing, but whether it is better to flood-fallow for 4 or 6 or 12 months with water 3 or 6 or 12 inches deep, with or without molasses, with or without lime, with or without a growth of water plants, with or without previous tillage. It is now a question of deciding not if sulphate of ammonia must be applied but—in view of market conditions for fertilisers and for sugar, in view of labour available—whether 2 or 4 or 6 cwt. per acre should be given; whether in one or several doses; whether in combination with phosphates or potash or limestone or any two of these or of all three; whether these various manures affect cane tonnage alone or also sucrose content, or juice purity or cane ripening and what is the effect of each type of fertiliser on each of these factors when that fertiliser is applied alone or in the presence of one or two or all of the others.

Our yields have reached a stage when it is unlikely that any variety or change in practice will be found which will increase the yield per acre by say fifty per cent. The merit of such a variety or practice would be obvious to all. But failing such we must look for the variety or practice that may add ten per cent. to our yield per acre. Ten per cent. on a crop of 140,000 tons of sugar would be 14,000 tons, a figure significant enough in the aggregate but not easily seen when spread over 60,000 acres. The determination of so small a change requires patience, and presistence, numerous and accurate field tests scattered over the Colony's cane area, carried through more than one complete cycle of plants and ratoons and extended over several years with varying climatic conditions.

The Sugar Bulletins of the Department, No. 3 of which has just been issued, illustrate clearly the complexity of the problems facing the industry and the modern method of attack. Every question must be answered by a series of carefully planned experiments where A is compared with B in the same field and under the same conditions. The soils of the entire cane area have to be examined, classified and mapped; the soil of each experimental site must be carefully analysed to determine the areas of which it is typical. Rainfall records have to be kept and compiled. Samples of cane have to be transported considerable distances and analysed when fresh. To perform these services requires money, time and co-operation. The sugar producers of the Colony, assisted by the Imperial Government and certain private firms, are providing the funds for the execution of this work, the members of the Department of Agriculture concerned and the staff of the Sugar Experiment Station are giving of their best, the estate managers and their staffs are rendering loyal and invaluable assistance. Definite progress has been made. It is established, for example, that:

(a) the varieties Diamond 10 and P.O.J. 2878 will outyield our present standard cane, D. 625;

(b) D. 625 does not ripen satisfactorily under local conditions, has an average sucrose content for this Colony, but has a purity below and a glucose ratio above the average;

(c) D. 625 is a heavy yielder as a plant cane and first ratoon but gives place to many other canes as a second ratooner ;

(d) 2 cwt. of sulphate of ammonia per acre is the optimum dose for plant canes of D. 625 on flooded frontland soils ;

(e) despite the marked acidity of our soils no marked increases in yield are to be expected from the application of lime-bearing materials ;

(f) on our frontland soils heavy applications of sulphate of ammonia to plant canes have no residual effect on the first ratoon crop ;

(g) marked increases in yield are likely to ensue if a system of under-drainage be installed connecting the open drains which divide our cane fields into beds 37 feet wide.

The execution of the work reported in the Bulletins has resulted from the co-ordinated effort of the Department of Agriculture on the one hand and of the sugar estates on the other. May this relationship continue, for assuredly co-operation such as this blesseth him that gives and him that takes. Within recent years the sugar industry has been faced with many acute problems, chiefly economic and external. To overcome these unfavourable circumstances internal improvements must first be effected. The British Guiana industry appreciates this. It is well.

BANANAS IN BRITISH GUIANA.

BY

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INTRODUCTION.

It has long been recognised that the establishment of an export trade in bananas would confer great economic benefits upon the Colony. Many authorities have made varied pronouncements and it is the object of this article to review, and bring up-to-date, as briefly as possible, (a) the results of past investigations and recommendations; (b) the results of recent investigations and recommendations; (c) the future prospects with recommendations; and (d) general hints on banana cultivation.

(a) RESULTS OF PAST INVESTIGATIONS AND RECOMMENDATIONS.

In 1888, Mr. G. S. Jenman, Government Botanist, wrote a paper "Regarding an Export Fruit Trade" in which he stated :—

> "I have shown that the land available for a fruit industry by far "exceeds the very largest trade our population could create; that the "proportion of the population free to take up such an industry is, "though not relatively so large owing to the different conditions of life "here as in Jamaica, sufficient for a considerable trade."

Sir Daniel Morris in Appendix A, page 87 of the report of the West Indian Royal Commission, 1898, wrote that the undeveloped Guiana lands were among the richest existing in any part of the tropics and stated that he knew nowhere else of such an extensive area of rich and fertile land with a comparatively healthy climate and within reach of such good markets as those lands in British Guiana. They could grow nearly every tropical product in demand either in the New World or in the Old. A view with which Sir J. Harrison did not concur.*

The lands described by Mr. Jenman and Sir Daniel Morris as being suitable amount approx. to 840,000 acres.

**Rept. Agr. Work of Bot. Gdns. & Govt. Lab. 1896—1902.*

In 1888, the Combined Court recommended[1] that a subsidy be granted to the Bay State Company in order to secure for the growers of fruit in this Colony a "regular means of sale and shipment of their produce at fair market rates." The company did not avail itself of this offer.

In 1890, a proposal[2] was received from the Boston Fruit Company that, in return for an annual subsidy of $25,000.00 for 5 years, a steamship service (fortnightly during the first year and thereafter weekly), should be established between British Guiana and the United States, the steamers being capable of carrying 10,000 bunches. The minimum prices offered for bananas were as follows :—

Bunches of 9 hands and over	...	30c.
„ „ 8 „	...	20c.
„ „ 7 „	...	10c.
„ under 7 hands	...	purchase optional.

No tangible developments resulted.

In August 1889, the first meeting was held of a Commission appointed by the Governor to consider means by which the banana and general fruit industry could best be encouraged. The Commission reported[3] :—

1. that few bananas were grown ;
2. that a less average price than 25 cents per bunch for bunches of all sizes would not pay the grower ;
3. that the kind of banana required by the American market was not cultivated ;
4. that the consensus of opinion was that the conditions of soil and climate and general circumstances of the Colony warranted a belief that the fruit could profitably be cultivated to meet export trade of 10,000 bunches a fortnight ;
5. that $10,000.00 be placed on the colony's estimates to defray preliminary expenses of encouraging the cultivation of suitable fruit for export ;
6. that as soon as the fruit industry could be encouraged with profit to cultivators and it was assured that within five years it would be self-supporting, a subsidy of $25,000 per annum for five years be granted to promote the Export Fruit and Banana Trade.

In 1890—91 the sum of $10,000.00 was placed on the Colony's Estimates in accordance with the recommendations of the Commission. This sum was not expended and it was considered that the responsibility of development at that stage lay with producers.

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[1] Report of Special Commission on proposed banana Industry and on minor Industries, 1895.

[2] Ibid.

[3] Ibid.

In 1909, a Commission was appointed[1] to enquire into "the question of the cultivation of bananas in the Colony and the possibility of establishing an export trade." In April of the next year, four members of the Commission were selected as delegates and went on a mission to Surinam to enquire into the details of the banana industry in that Colony.

The following were the conclusions arrived at by this Commission, of which Sir John Harrison was Chairman :—

1. "We are fully satisfied that the major part of the readily available front "lands of this Colony is not well suited to the production of bananas "on the commercial scale ; that it is quite hopeless to look for their "production on such a scale on the wind-swept abandoned lands of the "present sugar estates and of earlier cultivations ; and that the great "area of land otherwise well suited for banana cutivation which lies at "distances of from ten to thirty miles from the coast-line cannot be "successfully developed for such purpose in the manner similarly "situated land being so cultivated in Surinam. As already pointed "out no part of this Colony possesses the exceptional shipping advantages "the banana lands of Surinam enjoy.

2. "Those in control of banana plantations would have to allow themselves "not alone to be guided but to be autocratically directed and controlled "by the agent of the purchasing company. This we are certain that, "unless under stress of conditions that have not yet occurred in this "Colony, the planters and farmers of British Guiana would never "consent to.

3. "A banana industry as has been conclusively proved in Surinam can "only be carried on where efficient labour is available and under com-"plete control and the establishment of such an industry here would "inevitably require extension according to its scale of East Indian "immigration.

4. "Banana planters would be completely at the mercy of the United Fruit "Company and their purchasing agencies. The experience of Surinam "with the Gros Michel variety of bananas and the fact that the Panama "disease is not unknown in British Guiana show that they would be "compelled to fall back on the cultivation of the Congo variety. The "United Fruit Company have the monopoly of supplies of suckers of "that kind.

5. "At the outset we approached the Surinam manager of the United Fruit "Company as to whether his Company would be prepared to accept "bananas from British Guiana, and were informed that on receipt of

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[1] Report of the Commisson appointed consider the question of the cultivation of bananas in the Colony and the possibility of establishing an export trade in the product.

"letters in May from this delegation in regard to our projected visit he "had written his principals in New York who had cabled and subsequently written that the United Fruit Company was not prepared to "consider or to undertake any more contracts for bananas as the demand "during the past few years had not been increasing at the same rate as "the supply. The United Fruit Company owned large areas of land in "Costa Rica and other Central American Republics and we were informed by their Surinam Manager that if any extension of land under "banana cultivation was required the Company would rather extend "upon their own lands than make contracts with any other country or "association. That this extension was not likely to take place was "impressed upon us and we were informed that the Company had "lately changed very large areas of land which they own in Cuba from "banana cultivation to that of sugar-cane.

6. "We next enquired, as fully as possible, into the operations of the "United Fruit Company with a view to ascertaining whether it would "be possible to commence the shipment of bananas independently of "the Company. So impressed were we by the perfectly organised "business system of the United Fruit Company for obtaining their "bananas, placing them upon the market, and meeting any rival shipments that we are firmly convinced that it would be impossible for "this Colony to compete against them by an independently established "industry. They practically hold a monopoly of the banana industry, "handling most of the bananas that find their way into the American "and Canadian markets and controlling practically all the Gros Michel "bananas that go to the United Kingdom and other European countries. "Apart from the consideration of whether bananas could be grown "satisfactorily in this Colony, it was patent to us that without a contract with the United Fruit Company it would not be possible to "market satisfactorily any bananas that we might produce, and that "they were not prepared to offer us any hope that such a contract "would be entered into. In fact such a contract would be, as we have "already indicated, in direct opposition with the carefully thought-out "and deliberately adopted policy of the United Fruit Company.

"The delegation, therefore, is unable in the face of the results of the investigations which had led them to the above conclusions to offer to "the Commission either any hope of or any inducement for the establishment of a banana industry in British Guiana either at the present "time or in the near future."

In 1923, a Committee was appointed[1] by the Governor to report on the "question of an export fruit industry and the prospects of such an industry being successful or otherwise." The general findings of this Committee as stated by Sir John Harrison (Chairman) in 1925 were as follows :—

[1] C.S.O. File.

1. general unsuitability of the abandoned frontlands for banana cultivation;
2. suitability of special areas of the frontlands and of village lands for banana and fruit cultivation amounting to some 80,000 acres;
3. great area of fertile lands on the lower reaches of the Demerera, Essequibo, Pomeroon and North West Rivers amounting to about 430,000 acres;
4. vast areas of fertile land at present lying idle in the county of Berbice, in excess of 400,000 acres.

In November, 1925, there was a special meeting of representatives from the Chamber of Commerce, the British Guiana Sugar Planters' Association and the British Guiana Farmers' Conference to discuss the "possibility of developing a local or export fruit trade..........."

Among the recommendations of this Committee are the following:—

The principal difficulties to be overcome before an extended export in bananas could be inaugurated appeared as follows:—

1. that the banana cultivated must have keeping qualities;
2. that it must be immune from Panama Disease;
3. that a sufficient acreage must be planted to permit of minimum shipments of 30,000 bunches per fortnight;
4. that the cultivation must have easy and cheap transport facilities to the shipping point;
5. that the ships used for transporting the fruit must be properly equipped and fast, and that the industry must be well advanced before steamers would call for the fruit;
6. that such transport must be assured before cultivation on any large scale is undertaken;
7. that the whole industry must be under the coutrol of a fully qualified expert on the subject.

With reference to 1 and 2 the meeting was informed that Sir John Harrison had stated that there was in the Colony more than one species which filled these requirements, but it was recognised that the suckers from these that would be available for distribution among intending growers was infinitesimal in comparison with the number that would be required; and that it would be necessary to start the industry (unless the growers were in a position to plant trees with the object of obtaining suckers, and without any prospect of a market for the large proportion of the fruit grown) with a minimum area of about 4,200 acres, for which close on 900,000 sucker plants would be required. These figures are arrived at from the following statements which appear in an address by Professor J. Sydney Dash, B.S.A., at the Trinidad Agricultural Society in May 1925, reprinted in "*Tropical Agriculture*";—

"Under ordinary conditions it is hardly probable that an average yield of "250 straight bunches per acre per annum will be exceeded. In this connection "plants will yield a lower percentage of such bunches than first ratoons. In a "good banana section in Jamaica it is reported possible to get 330 "payable" "bunches over a seven-year period. Under those conditions 66 to 70 per cent. "of the plants and 88 to 90 per cent. first ratoons give straights.

"Mr. Scudamore of the United Fruit Company, who visited these islands "some time ago is reported in a Grenada paper as saying that with an expendi- "ture of £12, one acre of nurseries planted 6 feet by 3 feet (2420 plants), would, "when grown, be sufficient to set out 6 acres of bananas 11 feet by 11 feet."

It was quite obvious that the cost of obtaining so large a number of suckers would be prohibitive, even if it were possible, and that the only feasible means of obtaining the requisite number of plants would be to resort to nurseries, where only disease-free suckers should be planted. It was decided to urge on the Government the necessity for establishing the three cultivation plots of 100 acres each, referred to in His Excellency's speech at the opening of the Combined Court, as nurseries and distributing centres for approved banana suckers, citrus fruits and other economic plants and seeds. It was, however, the opinion of the meeting that after the establishment of the first 100 acre plot a larger number of plots, of say 10 acres each, distributed in various districts over the Colony, followingt he principle adopted in Trinidad, might be found to serve a better purpose in this respect, while at the same time demonstrating the suitability of the soil in each district for particular products and that these, placed under the control of efficient District Agricultural Instructors, and directly supervised by the Director of Agriculture, would prove less costly and have equally good results. Despite the literature available on the subject it was realised that a great deal had yet to be learnt from experience in this Colony gained in this way with regard to suitable varieties, soils, methods of cultivation, propagation and times to plant and prune, before any very extensive area was cultivated."

In 1930, Dr. C. W. Wardlaw visited this Colony on the instructions of the Empire Marketing Board to investigate the possibility of banana extension in this Colony and reported as follows :—

"In Surinam it was proved by a costly experiment, that there were no "extenisve areas of soil highly suited to the exacting requirements of the Gros "Michel banana. The latter is still the only banana acceptable in large quantities "to the European markets (*i e.*, leaving aside the Canary banana industry where "a short carriage and crating are pre-requisites.) Conditions in British Guiana "are very similar to those in Surinam, and when the possibility of a banana "industry is being considered it should be borne in mind that the soils of British "Guiana on which cultivation might be attempted (*i. e.* the coastal clay and "pegassey soils) are very similar to those which in Surinam had to beablandoned "after 3 or 4 years on account of Panama Disease. So far Panama Disease has "not been reported in the Colony, but as a supply of Gros Michel suckers would

"have to be introduced, sooner or later the disease would inevitably appear. "Optimists who might count on the probable absence of disease would have to "contend with the rapid decline in productiveness after two or three years as "already described. There is no doubt that satisfactory bunches can be produced "in the Colony. To create an industry, however, a certain minimum production, "say 20,000 stems per week, is required. This production must be regular and "continuous. To produce even this quantity requires a very considerable "amount of organisation and necessitates operations over an extensive acreage. "Facilities for the collecting of harvested fruit and for its transport to the quay-"side must be such as to ensure its being loaded with the utmost despatch—a "factor vitally important to the general well-being of the fruit in transport. In "Surinam, where the industry was organised on estate lines, it was only occa-"sionally found possible to send off ships with their minimum contracted cargo. "The difficulties in handling a corresponding industry not on estate lines but "among small farmers would be very considerable indeed. In the contract "between the United Fruit Company and the Surinam Government the planters "were given 36 hours' notice in which to cut and deliver their fruit to the "banana steamer. This is the usual type of expeditious handling of fruit re-"quired by the banana industry where transport is second in importance only to "actual production.......... Under existing external and local conditions "there can be little doubt that the establishment of a banana industry in British "Guiana would be a very uncertain and difficult undertaking."

It is evident from this historical summary that the establishment of a banana industry in this country has been a subject of controversy for many years. It is also evident that there has been unanimous agreement that such an industry would bestow many advantages on the agricultural community of the Colony. This has never been questioned. Committees and commissions have been appointed and have recommended the encouragement of banana extension. Government itself has demonstrated its approval of these recommendations and in one year voted a substantial sum on the Colony's estimates for the stated and specified purpose of banana cultivation.

(*b*) RESULTS OF PRESENT INVESTIGATIONS AND RECOMMENDATIONS.

As a result of the West Indian Fruit and Vegetable Conference held at Jamaica in October 1933, and at the request of the Director of Agriculture, Mr. N. E. Sanderson and Dr. V. C. Dunlap, (representing the United Fruit Company) visited the Colony for a period of about two months in order to investigate the possibilities of the establishment of a local banana industry. The result of their findings are given in the following letter dated July 10, from Mr. A. A. Pollan to the Department of Agriculture.

"I regret to have to advise that both Mr. Sanderson and Dr. Dunlap, who "have recently investigated the possibility of starting a banana industry in Brit-"ish Guiana, report conditions as being entirely unfavourable.

"Apart from the very real danger of rapid spread of Panama Disease on the "acid type of soils of Demerara, they consider soil to be unsuitable for produc- "tion of good quality fruit on a commercial scale, and, in addition, feel that "existing transportation facilities would mean that handling would be expensive.

"You will recall that we have previously looked into the possibilities of "British Guiana for bananas and that these earlier reports agree with the findings "of Mr. Sanderson and Dr. Dunlap. Under the circumstances, I am sure you "will understand that it is impossible for this Company to consider entering "Demerara.

"I should like to take this opportunity of thanking you for all the assistance "which our representatives have received at the hands of you and of members of "your staff. I regret that conditions were not found to be more suitable."

The matter of primary importance and which received the special attention of the U. F. Company's representatives was the nature of the Colony's soils and their suitability to the cultivation of bananas. In the first place it is well to consider the standards by which the experts of the United Fruit Company judge a banana soil. Mr. J. R. Johnston in a memorandum states:—

"Many factors influence the growth and productivity of the banana, but "where the Gros Michel banana is concerned in regions where the Panama "Disease is found, the pH* of the soil is one of the important ones.

"The Gros Michel banana can grow on a very acid soil, its ability to pro- "duce a good growth on such a soil being dependent on other factors than acidity.

"Wherever the fungus, *Fusarium Cubense* is found, it develops rapidly and "spreads rapidly in soils of a low pH, such as 5.5 and 5.6. I know of no ex- "ception to this. Such a low pH value would in no case allow a guarantee of "one crop of fruit being produced. Many such plantings have been made, often "without a single crop resulting, occasionally with one crop or a part of one and "some production the second year.

"As the acidity becomes lower in any particular soils, as for example a pH "of 5.8, one might expect more crops, but seldom more than three or four.

"In soils that are neutral or slightly alkaline, on the other hand, one may "often find bananas lasting for many years even when surrounded by diseased "bananas on acid soil.

"These statements, as I have made them, do not appear from our experience "to have any exceptions. In going over any of our regions where Panama "Disease is present it is easy enough to demonstrate these broad relations of pH "of the soil and spread of the disease.

"It must not be assumed, however, from this, that there is a simple direct "relation between pH and disease. That is to say that as the soils go from very "acid, 5.5 to less acid and finally to neutrality, one will not find always a propor-

*pH=a scale for measuring the alkalinity or acidity of the soil.

"tionate decrease in the amount of the disease and increase in the number of "crops possible from one planting. The subject is not so simple as that and is "complicated by other factors than pH.

"It, of course, is not the acidity alone that is the cause of the rapid develop- "ment of the fungus. Other factors, of which a low pH may be a symptom, "contribute either to the development of the fungus or to the susceptibility of "the host plant. For example, sandy soils may be both poor in plant nutrients "and very acid. Such soils, adjacent goods loams and light clays of a higher pH "value, quickly show the difference in growth and longevity of the plant. There "are also poor clay soils of a low pH, 4.5 to 5.5, that will not produce a single "crop of bananas.

"It is unnecessary to go into the chemical detail of the reasons for these "relations even if it were all known. It is sufficient to repeat that in the case of "the very acid soils where the fungus is present, there has appeared no exception "to its behaviour. In the case of the soils more nearly neutral, there are ex- "ceptions, and other factors must be taken into account in order to determine the "longevity of a planting.

"These differences are not confined to the spread of the disease but are "commonly evident in the individual banana plants. By this I mean that it can "commonly be determined by the appearance of the disease in a mat whether "such disease will spread rapidly or slowly.

"The caution may be added that pH values from 6.0 to 6.8 show less con- "stancy in their relation to the disease than do the extreme high and low. In "cases of moderate acidity other factors than pH must be given due consideration. "It may also be added that these observations apply to regular plantations of "bananas and not to a single mat or to a few mats. The behaviour of a single "mat or only a few mats in a locality should not be taken as indicative of what "a large planting would do on the same area.

"In partial explanation of these observations it may be helpful to note that "the most enduring soils are formed from limestone regions, and that residual "soils and soils formed from igneous rocks are usually short-lived.

"It is understood, of course, that these observations are given only as they "apply to the Gros Michel variety of banana."

Information was obtained from Dr. Dunlap during his stay concerning the attributes of a suitable banana soil. While no hard and fast rule was set in regard to soil acidity and its relationship to the incidence of Panama Disease yet the following connection was suggested.

TABLE I.

Age of plantation before Panama Disease causes abandonment.

Soil reaction (normal)	Age.
pH 4.0—6.0	Less than five years.
pH 6.0—6.7	Five years to ten years.
Above pH 6.8	Ten years or more.

As regards the texture of a good banana soil Dr. Dunlap considered that any value for the index of texture between twenty and forty-five indicated siutability. Any soil having an index of texture below twenty was likely to be too light while a soil with an index of texture above forty-five was likely to be heavy enough to necessitate replanting at frequent intervals. While the value for the index of texture serves as a rough guide, yet the best test is probably the feel of the soil in the field.

Bananas do not grow well on saline soils and Dr. Dunlap considered that salinity exceeding 0.050 per cent. was dangerous. The critical point, as far as salinity goes, naturally depends on soil texture and the salt tolerance of the banana may be taken as : sandy loam 0.030 per cent., clay loam 0.045. per cent., medium clay 0.050 per cent., and heavy clay 0.070 per cent.

A consideration of these standards indicated that the soils of the estates on the sea-board of the Colony were not likely to prove suitable to the cultivation of Gros Michel Bananas.

The results of the laboratory examination of 5,786 samples of topsoil and subsoil of the sugar estates are given in the Annual Report of the Chemical Division for 1932 (pp. 100—101). It will be seen that 95.3 per cent. of the topsoils possessed such a high acidity that Panama Disease might be expected to spread disastrously within five years. Only 27.2 per cent. of the topsoils possessed a favourable texture, While 84.7 per cent. of the topsoils contained only small amounts of soluble salts yet 51.2 per cent. of the subsoils contained sufficient amounts of soluble salts to cause them to be regarded with suspicion. A few visits paid by the United Fruit Cómpany's representatives to the sea-board estates soon convinced them that such areas were not likely to prove suitable.

The three main soil types of this tract are the frontland clay, the pegasse and the sand reef.

The *frontland clays* of the coastal regions, where sugar cane thrives, are considered to be of too heavy a texture unless frequent replanting is undertaken. These soils usually possess a normal reaction value of from pH 4.00 to pH 6.00. Banana cultivations on soil of such acidity, it has, been found by experience, are usually destroyed by Panama Disease in less than five years. Furthermore, in large areas, especially Berbice and the East Coast, Demerara, these soils possess amounts of soluble salts which would prove injurious. Finally, the high water table found in these soils during the wet season is likely to affect adversely the growth of the banana plant.

The *pegasse soils* usually possess a desirable texture and are seldom impregnated with soluble salts. They are, however, highly acidic (pH 4.00—pH 5.00) and Panama Disease is likely to spread very rapidly in such areas. Pegasse soils also usually possess a high water table, an undesirable condition where banana cultivation is proposed. In pegasse soils of considerable depth there is a danger of the plant being blown over.

The *sand-reef soils* of the coastlands often possess a desirable texture and are usually less acidic than the other soil types. Some of these sand-reef soils

are neutral or alkaline in reaction (a desirable condition as far as Panama Disease is concerned) but such soils also contain considerable quantities of soluble salts which will affect the growth of the banana. If the best sand-reef soils are to be selected it will be a matter of choosing between high acidity on the one hand and excessive salinity on the other hand.

Further investigations were, therefore, confined to the banks of the principal rivers and to such areas as had been specially mentioned by Sir John Harrison (*vide supra*). Tours were made by Messrs. Sanderson and Dunlap in company with officers of the Department and fifty-four samples of topsoil were collected at sites shown in the accompanying map and examined in the laboratory. The results are presented in Table II.

TABLE II.—RESULTS OF EXAMINATION OF BANANA SOILS.

Soil No.	Reaction, pH. Normal	Reaction, pH. Exchange	I.T.	Salts %	Truog Phosphate p.p.m.
1	5.15	3.94	43	0.019	12
2	5.05	3.90	47	0.044	21
3	5.39	3.81	47	0.015	12
4	4.98	3.97	52	0.013	17
5	5.79	4.46	20	0.014	11
6	4.97	4.36	---	0.115	29
7	4.68	3.81	41	0.044	15
8	4.41	3.64	46	0.024	13
9	5.20	4.23	51	0.041	13
10	4.85	4.16	33	0.015	10
11	5.39	4.28	32	0.012	—
12	5.60	4.03	50	0.025	—
13	4.51	3.69	48	0.027	—
14	5.27	3.90	57	0.011	—
15	4.82	3.89	55	0.029	—
16	4.82	4.18	41	0.013	—
17	4.77	4.29	41	0.022	—
18	5.03	4.26	11	0.023	—
19	4.72	3.90	44	0.016	—
20	4.83	4.09	32	0.016	15
21	4.49	3.97	31	0.016	14
22	4.53	3.78	54	0.044	21
23	5.57	4.71	35	0.013	14
24	5.35	4.22	29	0.015	11
25	4.97	4.04	38	0.021	18
26	5.10	4.17	36	0.011	12
27	6.28	5.34	30	0.016	13
28	6.63	5.56	42	0.054	—

TABLE II—(*Continued*).

Soil No.	Reaction, pH. Normal	Reaction, pH. Exchange	I.T.	Salts %	Truog Phosphate p.p.m.
29	5.66	4.80	50	0.132	—
30	5.36	4.16	54	0.087	—
31	5.81	4.80	48	0.150	—
32	5.75	4.36	43	0.021	—
33	5.04	3.88	54	0.042	—
34	5.27	4.04	47	0.013	—
35	5.41	4.17	48	0.019	—
36	5.51	4.36	56	0.061	—
37	6.13	5.38	29	0.022	—
38	5.56	4.39	23	0.024	—
39	4.68	3.82	30	0.021	—
40	6.43	5.68	25	0.024	—
41	5.45	4.56	59	0.072	—
42	4.63	3.94	50	0.170	—
43	6.97	6.02	12	0.016	—
44	5.11	4.05	37	0.016	—
45	5.56	4.31	42	0.017	—
46	5.32	4.10	46	0.026	—
47	4.70	3.94	46	0.021	—
48	4.97	3.87	42	0.013	—
49	5.17	4.10	26	0.018	—
50	5.00	4.04	56	0.016	—
51	3.25	2.44	67	0.171	—
52	4.92	4.29	60	0.213	—
53	4.54	4.23	34	0.657	—
54	5.34	4.09	46	0.027	—

In Table III the fifty-four samples are arranged in order of texture and acidity.

TABLE III.

Index of Texture	pH. 4.0 — 6.0 Less than five years	pH. 6.0 — 6.7 Five to ten years	Above 6.8 Ten years or more
Below 20 (Too light)	18		43
20—29	5, 24 3 8, 49,	37, 40	
30—39	10, 11, 20, 21, 23, 25, 26, 39, 44, 53,	27	
40—44	1, 7, 16, 17, 19, 32, 45, 48,	28	
45—49	2, 3, 8, 13, 31, 34, 35, 46, 47, 54.		
50 and above (Too heavy)	4, 9, 12, 14, 15, 22, 29, 30, 33, 36. 41, 42, 50, 51. 52, 6.		

It will be seen that according to Dr. Dunlap's classification forty-nine of the fifty-four samples collected (ninety-one per cent.) have normal reaction values below pH 6. 0 and, generally speaking, are likely to succumb to disease in less than five years. Of the remaining five soils, four of them might be expected to last from five to ten years. One of them, sample 28, contains a fair amount of soluble salts. The remaining sample, number 43, has a more favourable reaction but is apparently of too light a texture.

About twenty-five years ago a costly experiment was made in the neighbouring colony, Dutch Guiana, to establish an export trade of Gros Michel bananas. Due to the incidence of Panama Disease the venture was abandoned after three or four years. Before any definite conclusions were drawn concerning the possibilities of a banana industry in British Guiana it was considered advisable that the soils which had supported cultivation in Surinam should be inspected, sampled and

analysed. Arrangements were accordingly made for Mr. R. R. Follett-Smith, Chemist, to accompany Messrs. Sanderson and Dunlap to Dutch Guiana for this purpose.

During a short stay in Surinam three estates were visited and ten samples of soil were collected. These samples were examined by the Laboratory Assistant, Mr. L. A. Robinson and the mean results are presented in Table IV.

TABLE IV.

MEAN RESULTS of laboratory examination of Surinam Soils.

	Topsoil	Subsoil
Normal pH	4.76	4.82
Exchange pH	3.84	4.00
Lime Requirement %	0.639	0.580
Lime Requirement tons $CaCO_3$ / acre	9.6	8.7
Carbon %	1.367	0.815
Nitrogen %	0.188	0.126
Carbon : nitrogen ratio	7.26	6.42
% Organic matter	2.36	1.41
% Salts	0.026	0.073
Rate of solution	6	12
Index of Texture	52	53
Truog P_2O_5 p.p.m.	19	24
1% citric acid soluble P_2O_5%	0.0040	0.0031
Exchangeable and water soluble bases mgm. eqs. /100 gms.		
Lime	2.96	2.62
Magnesia	9.78	10.08
Potash	0.46	0.39
Soda	0.64	1.53
Magnesia : lime ratio	3.60	4.07
Available Iron	1.01	0.55

Comparing the mean values for the Surinam soils with those obtained in the examination of the clay soils of the sugar estates of this Colony it may be said that the former are slightly more acidic. Although they give similar values for the index of texture yet, in the field, they appear to be lighter and more friable. They are distinguished by their low content of exchangeable and water-soluble lime and their high content of exchangeable and water-soluble magnesia. They

appear to be well supplied with potash and to contain more exchangeable and water-soluble soda. Their contents of organic matter are lower while the amounts of nitrogen are similar to those contained in the clays of this Colony's sugar estates. The carbon : nitrogen ratios are narrower. The contents of available phosphate are lower than those encountered in East and West Demerara and are similar to those found in Berbice. The amounts of soluble salts are generally lower and the rates of solution are smaller.

The soils examined and sampled are similar to those occurring on the coastal belt of this Colony. Since their mode of formation is similar it is to be expected that the main differences would be attributable to variations in methods of drainage, cultivation and manurial practice. The plantations visited were all river estates; thus Peperpot is situated about 23 miles up the Surinam River while Sorgvliet and Rust en Werk are on the Commewijne river some 15 miles and 11 miles respectively from the sea. They are drained by gravity and possess no organised water conservancies. The soils collected were similar in friability to the soils encountered on the estates situated on the lower reaches of the principal rivers of British Guiana.

In general it may be said that the Surinam soils inspected are, on the whole, similar to those of the coastal belt of this Colony and that there is no obvious reason why the latter should not behave in like manner as regards crop production if given similar treatment.

In addition to the general unsuitability of the soils there are other important factors which are essential to the success of a banana industry, such as good transport facilities, low percentage of rejects, etc. These points were discussed at length with the U.F. Coy's representatives and in view of the announcement that the Canadian National Steamships contemplated supplying ventilated banana space on their steamers on the British Guiana run, it was hoped that opportunity would be afforded for shipments direct to Canada. From enquiries made, the capacity of these ventilated chambers is 6,000 cubic feet each, and as a bunch of bananas occupies 2¼ to 2½ cubic feet of space, 2,000 to 2,700 bunches would be required to fill up such space every fortnight. It is evident, therefore, that although space would be available, from the inspections made and the recent census taken, it would be extremely improbable that a supply of count bunches anywhere approaching this number could be obtained at the present time.

Since it is very important that bananas be kept at an even temperature during the time of transit, it is equally impossible for the United Fruit Company from this point of view to consider making contracts for small quantities and reserving space for such when these spaces could at present be filled to advantage from the Islands. This is an important point to remember since as long as the United Fruit Coy. or the C.N.S. Coy. can fill these spaces elsewhere to the maximum, it is unlikely that such a large cooling chamber will be put at the disposal of this Colony only for a few bunches. Storage Chambers cannot be opened

up andclosed down indiscriminately, as this interferes with the ripening qualities, etc., of the bananas. Another very important point is the loss that would be involved especially at the beginning to farmers on account of rejects and it is essential if an export trade is made possible in the near future for the farmers to be well informed in this connection.

As a matter of interest some 25 count bunches of bananas were obtained from various districts for examination by the U.F. Coy's representatives. The percentage of rejects was very high. Bananas which are not acceptable to the trade and are classified as rejects are as follows : (1) All bananas not of the Gros Michel type ; (2) Bunches with a complement of hands below that of a count bunch, *i.e.*, with less than 8 hands; (3) bruised bananas; (4) stems that have been picked too soon or too late ; (5) badly-formed bananas ; (6) short-fingered bunches ; and (7) bananas whose skins have been damaged by flies or insects.

It can be seen therefore that the marketing and export of bananas is a very specialised business.

(c) THE FUTURE PROSPECTS AND RECOMMENDATIONS.

It was hoped that the visit of the U.F. Coy's representatives might have resulted in securing contracts for the export of bananas as was done in the Islands and that the farmers would have been able to market small quantities as they became available. Due, however, to present soil conditions, the great scarcity of the right type of banana (the Gros Michel), the inability to secure sufficient quantities necessary to fill a ventilated chamber regularly, it was impossible to make such contracts. Also, in Trinidad, there had been fairly large surplus stocks available for export which is not the case in this Colony. This has been due to the long established custom of growing bananas as a shade and protection crop for cacao. It is evident, therefore, that the first step to be taken, is to grow larger quantities of the Gros Michel type (the only variety at present acceptable to the trade) for local consumption. In this Colony the Cayenne and Oronoque varieties are of the Gros Michel type and for the purpose of export such names can be regarded as synonyms. The Department's policy has been and will continue to be the supplying of proved suckers of these types to farmers. At the present moment, nurseries are being extended by collection of these types for cultivation and extension.

The next step will be to carry out the policy of the Department by making tests in five to ten-acre blocks and to study the economics of such cultivations in different areas and under different soil conditions. It was evident from the inspections recently carried out, that the percentage of count bunches from the ratoon crops was particularly low and as the profits of such an industry depend on the success of the ratoon crop, such experiments will serve the purpose of clearing up this question. The planting of these 5-acre blocks will also definitely prove, whether the local banana varieties known as Oronoque and Cayenne (Gros Michel types) are immune to Panama Disease.

In addition to these block trials, which it is proposed to undertake, preparations have already been made for trials to be made under "flood-fallow" conditions at the Georgetown Experiment Station.

At the present time export is by bunches only and as the trade can meet its requirements in this manner from the chief banana-growing countries of Jamaica and the Central and South American Republics, efforts should be made (i) to obtain sales by hands or by weight in order that the objectionable loss by rejects would not arise; the objection on this score, of course, is the additional expense incurred in freight, etc.; (ii) to produce sufficient quantities so as to be in a position to inaugurate a regular supply. The United Fruit Company's representative informed me when that positon had been reached, they would gladly enter the market as potential buyers.

(*d*) HINTS ON CULTIVATION.

In view of the recommendations made above for the increased cultivation of bananas in the first instance for local consumption, a few notes and points to be observed during cultivation are given below.

In the first instance, rainfall should be from 80-100 inches a year and fairly well distributed. The soil must be well forked or ploughed and a good drainage system established. When a good tilth has been obtained the suckers planted should be at least six to eight inches across at the base and should be planted in a hole at least 16 inches square and 16-24 inches in depth, at a distance of 10 by 10 or 12 by 12 feet apart. If the soils are friable a very successful method adopted in some countries is to plant two suckers in holes spaced about three feet apart at the above distances to take the place of one sucker. Good drainage is specially stressed because the banana is one of the most susceptible plants to water-lodging and good crops can only be obtained when the water is maintained at a level below the rooting depth of the banana.

Good aeration and the removal of injurious salts or chemical compounds are also insured if good drainage is maintained. During growth good inter-tillage is necessary and forking around the plants should be encouraged, but whatever is done the plants should not be moulded around the roots because of the encouragement given in the development of suckers at the top. High suckering is to be avoided and all cultivation should cease once the fruits commence to form and to mature. If good inter-cultivation is carried out at the commencement and up to a period of 4-6 months after planting, then very little further cultivation will be necessary.

SUMMARY.

Most people will agree that the establishment of an export banana industry would confer considerable benefits on this Colony. The desirability of a banana industry and the possibility of a banana industry are, however, not the same. That its establishment is possible has been the opinion of Jenman, Sir Daniel

Morris and, at one period, of Sir John Harrison, but with this view, some have differed, and in this latter class must be included those workers having first-hand experience of banana cultivation in countries producing bananas on a commercial scale.

The views of authorities, however respected, are, in the final analysis, only views. Banana cultivation has shown itself to be one of the most profitable tropical agricultural industries, and it hardly seems rational that views even of authorities, should damn the extension of such an industry in this Colony if economic consideration justified it. One fact is obvious, namely, that despite much discussion and encouragement during the last forty years, banana cultivation has not progressed in this Colony.

The experiments now being carried out therefore, are of great value, and should prove or disprove the future economic possibilities of establishing such an industry in this Colony.

THE COCONUT CATERPILLAR, *BRASSOLIS SOPHORAE* L. (LEP. BRASSOLIDAE) IN BRITISH GUIANA.

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CONTENTS.

INTRODUCTION.

Coconuts are the third most important crop in British Guiana at the present time, and the area under cultivation in 1933 was estimated at 23,452 acres. The palm is grown principally on the coastal belt on such areas of sandy loam as occur interspersed through the heavy alluvial clays of this portion of the country, but a not inconsiderable proportion of the cultivation is on such clays themselves.

Considering the conditions under which the crop is grown the palms make remarkable progress, and the yields both as regards the number and size of nuts are good.

*Seconded as Entomologist-in-Charge, Sugar-cane Moth-borer Investigations, British Guiana. (Colonial Development Fund), July 9, 1931.

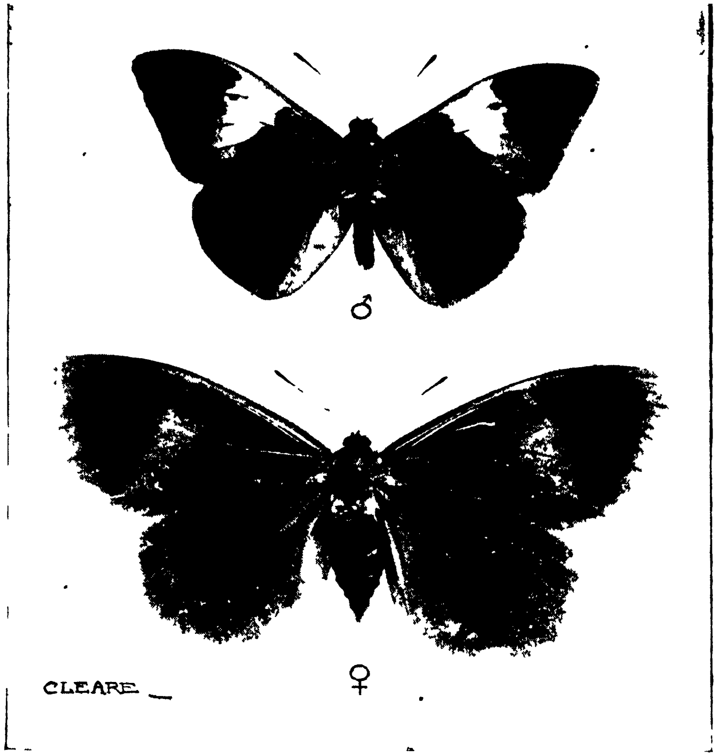


FIG. 1.—The Coconut Caterpillar *Brassolis sophorae* L. Male butterfly above; female butterfly below. About natural size.

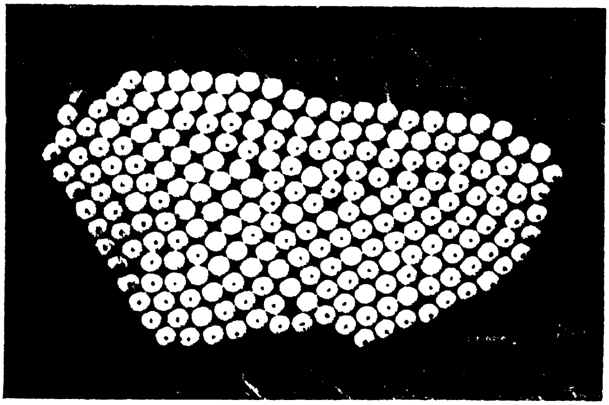


FIG. 2.—Egg mass of the Coconut Caterpillar, *Brassolis sophorae* L. About twice natural size.

Owing to the low-lying condition of the land the larger areas under cultivation are divided, as is the custom of the country, into "beds" by drains of some two feet wide at frequent intervals—often 37 feet apart—which are themselves but sections of larger portions termed "fields" bounded by ditches or trenches. In spite of this system of water channels it often happens that the coconut cultivations are not well drained, although there may be sufficient water movement to meet the requirements of the palm. In addition also a considerable amount of vegetation is often allowed to appear between and below the palms which may in places become rank.

A number of insect pests are recorded as occurring on the coconut palm in this colony, but many of these are of minor importance.

The Coconut Caterpillar (*Brassolis sophorae* L.) is probably the most damaging insect of this crop in the colony, and from time to time severe outbreaks of this insect occur in the different areas of the coastal belt.

In dealing with the outbreaks of this insect which have occurred on the coastal area over a period of many years a not inconsiderable amount of information has been acquired on the biology of the pest, its natural enemies, and methods to be adopted for its repression. In the present paper an attempt has been made to bring together this information not merely as a record of what has been accomplished, but also with the hope of its serving as a basis on which future work on the insect and campaigns against its attacks may be undertaken.

This paper, although presented as a joint contribution and the responsibility of the statements made herein shared by both writers, represents to a considerable extent independent work. The senior author is solely responsible for the work up to October, 1931, after which the junior author continued with the work.

In carrying out the work the writers have been assisted both in the field and laboratory by Mr. C. Williams, Laboratory Assistant in the Entomological Division of the Department of Agriculture. In addition a few observations of Mr. Williams are included, in each instance acknowledgment has been made in the text.

BIONOMICS OF THE COCONUT CATERPILLAR.

HISTORICAL.

The earliest record of the coconut caterpillar from the Guianas appears to be that of Jungfrau Maria Sybilla Merian in 1705 in her "Metamorphosis Insectorum Surinamensis" (18),* and although the food-plant figured appears to be

*This work has not been seen, but in the 4th (posthumous) edition "Over de Voortteeling en Wonderbaerlyke Veranderingen der Surinaemsch Insecten," published in 1730 in Dutch and French under the above title, this quotation appears.—L.D.C. and F.A.S.

Müllera moniliformis L., she adds "Later on I found a very large number on a high coconut tree ; . . . . . . on this tree these caterpillars had made or rather had spun a bag." While the food-plant is wrongly given the characteristic "nest" which the larvae construct is described. In this work the adult insect as well as the larva is figured.

Schomburgk (20) in his "Fauna und Flora von Britisch Guiana" (1848) records this insect as occurring on the coastlands, and says that it is "To be found on the coasts. Here they generally fly through the open windows and doors into the buildings.

In spite of this remark, which suggests that the insect was particularly prevalent at the time, Schomburgk made no statement of damage to coconut palms which if it had occurred one would imagine could not have escaped the notice of this very acute observer.

The insect does not appear to be recorded again until 1891 when Quelch (19) notes that "Quite recently, moreover, the various cabbage palms (Oreodoxa) about town, and not a few of the coconut and other palms have been more or less stripped of their leaves owing to the ravages of some small lepidopterous larvæ, which, after stripping the trees so as to have the bare mid-ribs and lateral fibro-vascular bundles more or less naked, make distinct compound nests by the union or lacing together of part of other leaves, in which chrysalids are placed . . . . . . Now, some nine days after, more than two dozen imagos have hatched out, shewing the common yellow-barred butterfly, *Brassolis sophorae* . . . ." Thus we have the first record of an outbreak of the pest.

In 1893 the insect was again recorded (1) as attacking "palms" in Georgetown and its neighbourhood. It is evident that cabbage palms (Oreodoxa) were then attacked, but no mention is made of damage to coconut palms on that occasion.

The next record we have been able to find, and apparently the first of an extensive outbreak is that of Bartlett (2) in 1905 when the insect occurred in considerable numbers at Pln. Grove, near Clonbrook, on the East Coast, Demerara, and when, it is stated, "large areas of coconuts were considerably damaged." In 1909 there was another outbreak of this insect, on that occasion in the Mahaicony district, when Stockdale (21) (22) reported upon it. On both of these occasions the palms in Georgetown were attacked also.

In 1912-13 there was an outbreak of the coconut caterpillar which extended into 1914 and caused extensive damage to coconut palms in Georgetown. The senior writer investigated this outbreak and reported upon it (5) (6). Since that time outbreaks of a greater or lesser intensity have occurred annually in some part of the coastal area.

Geographical Distribution.

The genus *Brassolis* is indigenous to the Neotropical region, from Panama to South Brazil and Peru. The coconut caterpillar, *Brassolis sophorae* L., occurring from Guiana to South Brazil. Fruhstorfer (13) says that the four known local forms are distributed on the Atlantic side to Rio Grande do Sul, and on the Pacific certainly as far as Peru. These forms are those recognised by Wytsman, namely *Brassolis sophorae sophorae* Linné, Guiana to South Brazil; *B. sophorae larida* Stichel, Colombia; *B. sophorae vulpeculus* Stichel, Paraguay; and *B. sophorae ardeus* Stichel, South Peru.

Brassolis sophorae sophorae L. occurs in Trinidad (14), (15), (16), (17), also where it is a pest of coconut palms. In British Guiana *Brassolis sophorae* L. occurs commonly on the coastlands, and outbreaks of this insect have been observed on different occasions over almost the entire coastal area. On one occasion an egg-mass of *Brassolis sophorae* L. was received from St. Mary's, Konawaruk R., Potaro district, where it was found on the trunk of a coconut palm, but the evidence is not conclusive as the eggs failed to hatch.

Systematic History and Synonymy.

Brassolis sophorae was first described under the name *Papilio sophorae* by Linné in 1758, the name type coming from Guiana. This insect was known, for some time prior to this, however, for as previously mentioned, both the adult and larva were figured and the habits of the larva dealt with by Juffreu Merian in 1705 in her "Metamorphosis Insectorum Suninamensis". In 1764 Clerck described the insect again and figured the type. In 1779 Goeze re-described it, giving it the specific name *rufescente-fuscus*. Kleman also figures the insect, and Cramer in his Papillons Exotique (1782) also treats the insect. Fabricius first placed the insect in the genus Brassolis in 1807 where it now stands.

The synonymy of the species as given in Wytsman, Genera Insectorum 1906 is as follows:—

1. *Brassolis sophorae* Linné.

   a. *Brassolis sophorae sophorae* Linné.

   Papilio sophorae, Linné, Sust. Nat. (10), p. 471, No. 83 (1758).

   Papilio sophorae, Linné, Mus. Lud. Ulr. p. 266 (1764).

   Papilio sophorae, Clerck, Icon. Ins. t. 35 (fig. typ.) (1764).

   Papilio rufescente fuscus, Goeze, Ent. Beitr. No. 1. 3 (I,) p. 223, No. 87 (1779).

   Papilio sophorae, (Fabricius M.S.), Illiger, Mag. Ins. Vol. 6, p. 282, No. 16 (1807).

   Brassolis sophorae, Godart, Enc. Meth. Zool. Vol. 9, p. 457, No. 1 (1819).

   Brassoliis sophorae Sepp, Surin. Vlind. p. 309, t. 143 (biol.) (1848).

Brassolis sophorae, Westwood (u. Hewitson) in Doubleday, Westwood U. Hewitson, Gen. Diurn. Lep. t. 59, f. 2, (1849).

Brassolis sophorae, Burmeister, In Rev. Zool. (3), Vol. 1. p. 46, (biol.) (1873).

Brassolis sophorae, Aurivillius, in Sv. Akad. Handl. Vol. 19, p. 72. (1882).

Brassolis sophorae, Staudinger (u. Schatz), Exot. Schmett. Vol. I. p. 211, t. 71 (1887)

Guiana to South Brazil.

b. *Brassolis sophorae lurida* Stichel.

Brassolis sophorae luridus Stichel, in Berl. Ent. Zeit. Vol. 46, p. 520.

Columbien.

c. *Brassolis sophorae vulpeculus*, Stichel.

Brassolis sophorae vulpeculus Stichel, in Berl. Ent. Zeit. Vol. 46, p. 520 (1901).

Paraguay.

d. *Brassolis sophorae ardens* Stichel,—Tag. 3, Fig. 1.

Brassolis sophorae ardens, Stichel, in Ins. Borse, Vol. 20, p. 389, No. 1 (1903) (2).

Sud-Peru.

FOOD-PLANTS.

On the coastal area the principal food-plant of this insect is the coconut palm (*Cocos nucifera*), but the cabbage palm (*Oreodoxa oleracea*) and the Royal palm *O. regia*) are also frequently attacked. A few other palms have been observed to be attacked also during outbreaks of the insect, namely, *Livinstona altissima*, *Archontophoenix Cunninghamii*, the Kamawari Palm *Desmoncus major*, *Bactris sp.*, and *Euterpe sp.*, while Bananas, *Musa sapientium*, and Plantains *Musa paradisica*, have been observed to be attacked on occasions as well. On one occasion a "nest" of these larvae was obtained (L.D.C.) on sugar-cane, and successfully reared the insects to maturity on this food-plant.

Jufg. Merian (18) in her account of the insect suggests rather than states definitely that the insects feed on the plant, which from her figure appears to be *Müllera moniliformis*. Her description of the plant is too brief, however, to make indentification certain, but Mr. E. B. Martyn, Government Botanist, who has been kind enough to give us his opinion, states that the plant figured probably belongs to the same section of the *Leguminosae* as *Coronilla* which she names as the host plant. In this, however, it is evident that she was in error.

Quelch's (19) statement "which in my own experience hitherto had only been known as attacking the various forms of lilies, and especially species of *Hippeastrum*" is, however, definite and for this reason more puzzling.

The writers have never observed *Brassolis sophorae* to feed on lilies, nor can they find any other reference to this food-plant in the literature at their disposal. In view of the range of food-plants given, an occasional record of this nature would be possible.

Jose de Campos Novaes (19) gives *Orbignia racemosa, Attalea regia* and *Cocos gevota* also as food-plants.

Economic Importance.

Taken over the entire coastlands *Brassolis sophorae* is probably the most injurious insect of the coconut palm in British Guiana. From time to time extensive and devastating outbreaks of the insect occur in the different districts of the coastal area where they inflict severe damage to the palms and extensive loss of crop.

Coconut palms that have been severely attacked by this pest lose an entire crop of nuts, and a period of from twelve to eighteen months after such an attack must elapse before there is another crop available for picking. In addition a number of the palms die when the attack has been severe.

In an outbreak of the pest which occurred in Georgetown in 1914, Cleare (6) estimated that 5 per cent. of the coconut palms in the city had succumbed as the result of attack by this insect.

While it is difficult to estimate the loss caused to the industry in this colony through the attacks of the coconut caterpillar it is without doubt a considerable sum of money, for on a single plantation the loss caused by an outbreak of this pest will amount to thousands of dollars.

On some plantations where crop returns have been kept for a number of years it has been found that following a severe outbreak of the pest there may be a loss of as high as 47 per cent. of the entire crop, and it must be remembered that such figures would include areas only slightly attacked or which even may have escaped injury.

In addition, the cost of control measures must be considered. On one plantation from which it has been possible to obtain figures in this connection the amount expended on controlling the insect worked out at an average of $1.00 per acre of the whole cultivation, or about $4.00 (16/8d.) per acre attacked.

There have been other outbreaks in which to the writer's knowledge the cost of control work must have been somewhat in excess of that given above, but it has not been possible to obtain figures in connection with these.

Outbreaks of the coconut caterpillar have been recorded on the coastal area of all three counties of the Colony, namely, Berbice, Demerara, and Essequibo, the area in which attacks have been observed being from Skeldon on the Coren-

tyne Coast in the eastern part of the Colony, to as far as Hampton Court on the Essequibo Coast in the west, and extending over a seaboard of about 120 miles. Of these areas the County of Berbice is affected least, as a rule, although severe outbreaks have been observed there, and the County of Demerara, with especially the Mahaica-Abary area and the City of Georgetown, being the most seriously attacked. No records of the insect have been received from the Pomeroon or the North-Western Districts up to the present.

Of the number of other palms attacked by the coconut caterpillar the only ones that need be considered here, are the Cabbage Palm and the Royal Palm *Oreodoxa oleraeea* and *O. regia.* In outbreaks of the insect in Georgetown these palms are at times seriously attacked and occasionally die as the result of the damage so caused. The value of these palms in the formation of avenues for beautifying of towns and their comparatively slow growth and consequent long period necessary to replace them, justifies more attention being paid to them generally, and particularly as regards the control of attacks of the coconut caterpillar and other insects.

NATURE OF INJURY.

Coconut palms that have been severely attacked by this insect are stripped of their leaves and little left but bare mid-ribs. (Plate III, Figs. 1 and 2.) Palms so denuded have a peculiar grotesque appearance, in a general way being not unlike an umbrella stripped of its covering. During severe outbreaks of the pest it is not an infrequent sight to see large areas of palms completely defoliated as the result of the ravages of this insect. On such occasions the damage is so extensive and conspicuous that it attracts the attention not only of the entomologist but also of the layman, for the devastated palms are the most conspicuous feature of the landscape in the district in which they occur, and may be seen for miles around.

At first the damage inflicted by the caterpillars is slight and not noticeable, but as they grow older and devour larger quantities of leaves, the damage becomes conspicuous and assumes importance. As the caterpillars grow in size they make "nests" by drawing together a number of the leaves on a branch by means of a tough silken web which they spin, and in these "nests" they hide during the day emerging at night to feed. In a severe attack these "nests" are often the only pieces of leaf left on the palm, and are conspicuous objects. The caterpillars do not always make "nests", however, but sometimes hide about the bases of the leaves, in the "heart" of the palm as it is termed locally, in the fibrous material there.

CAUSES CONDUCIVE TO AN OUTBREAK.

There is no evidence to suggest, and no reason to believe, that the outbreaks of the coconut caterpillar which occur periodically on the coastal areas are the result of migrations of the insect from other parts of the colony. Within local areas there may be, and probably are, movements of the butterflies from one

property or area to adjacent ones which later become infested, but such movements of the insects are purely local and do not extend for any distance. This is only, what one may expect from the comparatively weak powers of flight of the butterfly.

The outbreak of this insect which occurred in Georgetown in 1912-13 which has been reported upon by Cleare (5) (6), will serve to bear out this latter point. On that occasion the City of Georgetown was severely attacked, and of that area the Ward of Alberttown situated in the north-eastern part of the city was by far the most heavily attacked portion, but, in spite of this, Kitty Village, which is situated to the north-east of the city and separated from it only by the Ward of Queenstown, a width of about half-a-mile against the prevailing north-easterly wind, escaped the attention of the insect. It should be pointed out, however, that the insects spread across the town itself in a general south-westernly to north-easternly direction against the prevailing winds. The explanation of this is to be found apparently in the fact that in Georgetown itself where palms occur in nearly every city lot the distances of flight would be short between palms, whereas between Alberttown and Kitty Village the distance between palms would in most instances be a matter of several hundred yards against the prevailing winds, which distance apparently the insects were not capable of crossing. Nor did the insects cross the Demerara River, a distance of a couple of miles, with the aid of the prevailing winds and infest palms on the western side of the river, although instances have been observed in other districts where the insects appeared to have taken advantage of favourable winds and infested adjacent properties, but on these occasions the distance covered was only a few hundred yards. It is true that the butterflies as well as the other stages of the insect are at times accidentally transported by the movement of persons and vehicles from one district to another and also occasionally in the movement of bags of coconuts, but the amount of distribution which takes places in this manner of one district from another is not believed to be of any importance.

If, then, the insects do not migrate to the areas on the occasion of outbreaks, and will apparently travel only short distances to infest areas, to what must be ascribed the periodic outbreaks? This is the question one is sometimes asked, and as the answer is of importance in the general control of the pest, it would seem desirable to deal with it here.

Primarily, of course, outbreaks occur through the absence of the natural enemies of the pest, principally the insect parasites, and the causes which lead to this are complex and are not easily determined. But apart from this and weather conditions, there can be little doubt that very important contributing factors are adverse agricultural conditions, taken in the broad sense. Perhaps the most conspicuous of these is the accumulation of husks under palms after their removal from the nuts.

It is a practice on some plantations to husk the nuts in the fields in order to facilitate transport, and as the result accumulations of discarded husks are left in the fields, often about the bases of the palms. (PLATE IV. Fig. 1.) These heaps of husks are from time to time also augmented by fallen leaves, twigs and weedings of the fields and the whole collection left from year to year with the idea, it is said, of allowing it to decompose and fertilize the palms. From most points of view such a practice is undesirable for not only does such material take a long time before it is sufficiently decomposed to be available for use by the plant, but in addition it affords the coconut caterpillar with conditions which are highly suitable for its protection and inimical to the work of its parasites.

The coconut caterpillar in seeking a place to pupate often falls to the ground and there continues to wander around in search of a suitable place to transform. Should there be accumulations of husks in the vicinity it seizes upon the opportunity of shelter thus offered, and hiding itself amongst the husks pupates there. When thus hidden the pupa is comparatively free fom the attacks of its parasites. It can be readily seen that such a practice, where it is extensive, would assist considerably in bringing about an outbreak.

Accumulations of coconut palm leaves, weeds, and other *débris* act in a similar way.

LIFE HISTORY AND HABITS.

THE EGG.

(PLATE I, FIG. 2.)

The eggs of the coconut caterpillar are laid in masses indiscriminately on the different parts of the palm such as the leaves, leaf-bases, the fibrous material about the leaf-bases, and on the nuts themselves. They may also be found on the trunk of the palm, sometimes within a short distance of the ground, and occasionally even on débris collected beneath the palms.

The eggs are deposited in a single layer close together though not actually touching, and are cemented to the surface on which they are deposited. Egg-laying takes place during the hours of darkness, but the actual time of oviposition has not been observed. The number of eggs which a female is capable of laying would appear to be between 200 and 300. In dissections of six females the average number of eggs per female was 261, with a minimum of 214 and a maximum of 294.

The number of eggs in one mass varies somewhat, from only a few eggs to as many as 260 eggs. In a lot of 22 egg-masses the number of eggs per mass varied from 43 to 221, with an average of 136 eggs.

The length of the egg-stage is about twenty to twenty-five days.

THE LARVA.

(PLATE II, FIG. 1 AND TEXT-FIG. 4.)

Shortly after emergence from the eggs the larvae of *Brassolis sophorae* devour the shells from which they have issued leaving only the lower parts ad-

hering to the surface to which they were attached. During the first twenty-four hours after emergence they do no other feeding, but remain motionless huddled together in a mass, their heads all pointing in one direction. From the very first, therefore, they display the gregarious habit so characteristic of the larval life. At the end of this period they commence to feed on the leaves of the palm. At first they may wander about in search of a suitably tender piece of leaf on which to commence, and in doing so proceed in a long line, the head of one larva almost touching the anal end of the preceding one.

In the beginning the larvae eat only a small amount, and hide in the folds of the leaflets. After twelve to fourteen days, and the completion of the first ecdysis, the larvae commence to feed with greater activity. They now draw together the edges of the leaflets by means of a silken web which they spin, and in these pockets they hide during the day, thus exhibiting the beginnings of the formation of the nests which are characteristic of the later larval stages.

From then on their feeding becomes extensive, the larvae grow with surprising rapidity. Larger "nests" become necessary and are formed by drawing several of the leaflets together into cylindrical pockets, open at both ends, by means of a tough brown silken web. Of 68 nests examined the average number of leaflets comprising a nest was 6.8 with a minimum of 2 leaflets and a maximum of 40 leaflets. In the nest a tough silken bag is formed, which extends for about half-way down its length, the caterpillars confirming themselves to this portion of the nest, excrement and grass occupying the space below it.

In these "nests" which are about eighteen to twenty-four inches long, or the entire length of the leaflets, several hundred larvae may collect, their heads all pointing in the same direction, and a single "nest" may weigh as much as two pounds. In these "nests" the larvae hide during the day, emerging at night to feed. Sometimes the larvae hide in the "heart" of the palm about the basis of the leaves. When the fully grown larvae move from place to place they also do so in procession also after several individuals in width.

Soon after dark the caterpillars emerge from their hiding places and after wandering about in procession for some time commence to feed. Feeding continues for about an hour, after which the larvae return to hiding for the rest of the night. Caterpillars kept under observation in the laboratory generally did not feed after 9 p.m.

AMOUNT OF FOOD CONSUMED.

In laboratory experiments on the feeding of the larvae it was found that with an average of 36 full grown larvae of this insect about 49 square inches of foliage of the palm was destroyed nightly. The data as regards the amount of foliage consumed nightly are given in the following Table I.

TABLE I.—Quantity of food eaten nightly by full grown larve of *Brassolis sophorae L.*

Day	No. of larvae (fullgrown)	Foliage Eaten	
		Total	Average per larvae
1	39	39.7	0.8
2	38	47.8	1.3
3	37	54.5	1.5
4 & 5	37	110.2	3.0
6	37	53.2	1.4
7	37	46.5	1.3
8	36	45.3	1 3
9	30	42.8	1.4
Mean	36.4	48.8	1.5

Calculations based on these figures, and the leaf area of a palm, as well as observations of the normal rate of destruction of palms in an outbreak of the pest, indicate that the consumption of foliage in this experiment was considerably less than that which occurs under natural conditions in the field.

DURATION OF INSTARS AND LENGTH OF LARVAL LIFE.

The length of each instar and the total length of the life of the larva as obtained at Georgetown between the months of March and August were found to be as follows :—

1st instar	...	...	10 days
2nd instar	...	...	8 to 9 days
3rd instar	...	...	8 to 9 days
4th instar	...	...	9 to 10 days
5th instar	...	...	11 to 12 days
6th instar	...	...	12 to 13 days
7th instar	...	...	18 to 28 days.

Total length larval life (including pre-pupal period) 76-91 days. The larval period of 11 individuals varied from 76 to 85 days with an average of 79.6 days.

Measurements of the head capsule of the various instars is given below :—

Instar			Breadth of head Capsule	
1	...	...	1.0—1.1	mm.
2	...	...	1.6—1.7	,,
3	...	...	2.0	,,

Instar			Breadth of head Capsule	
4	...	...	2.5—2.6	mm.
5	...	...	3.5	,,
6	...	...	4.5—5.0	,,
7	...	...	5.5—6.6	,,

ECDYSIS.

About two days prior to making a cast of skin the larva becomes swollen and distended just behind the head, having a somewhat inflamed appearance. The larva does not feed, appears sickly and rests quietly. On the following day the anal end of the larva exhibits a similar swollen appearance. These swollen areas which occupy a total length of nearly one-half the larval length in the younger stages are in a distinct contrast to the remainder of the body which is usually darker in colour as well as distinctly smaller in size. In the first ecdysis these swollen areas are red in colour, but in the subsequent ecdyses are at first a light brown becoming dark brown on the second day, these colorations being no doubt due to the colour of the head and anal prolegs of the approaching instar. Larvae in this stage are easily distinguished.

PREPUPAL STAGE.

When the larvae are ready to pupate they become active even during the daytime, and wander about in search of a suitable place in which to transform. The gregarious habit which has been so strongly developed up to this time is now completely given up and each larva wanders off on its own. In these wanderings a large number of the larvae (perhaps the majority) fall from the palms, landing with a distinct thud if the ground below is bare. In a severe outbreak when this stage is reached literally hundreds of larvae may be seen roaming about the ground in different directions at a surprising speed. Nothing appears to deter them in this search for hiding places, for they will cross trenches filled with water in numbers, or even ascend the sides of houses.

Having found suitable sheltered places the larvae cease their roaming and become inactive. They then attach themselves by the anal end and noticeably contract in size, the inter-segmental constrictions becoming well defined, the segments themselves each taking on a more rounded form and in general the larvae appearing humped, quiescent and lifeless. If in a position that allows of it they suspend themselves head downwards, and in a short time pupation occurs.

The larval skins are thrown off and the exuviae, together with head capsules, may be found entangled in the silken threads from which the pupae are suspended.

The pre-pupal period is usually from one to two days, but may extend to three or four days, and in one instance was observed to extend to six days.

THE PUPA.

(PLATE II, FIG. 2, AND TEXT-FIGS. 5 AND 6.)

WHERE PUPATION TAKES PLACE.

Pupation may occur on the palm, or as pointed out elsewhere, in almost any place that affords suitable shelter within a reasonable distance of the palm on which the larvae developed. Accumulations of leaves, husks, and other debris when they occur under the palms offer suitable places and are much used by the insects in pupation, but the sides of houses and even under buildings themselves are frequently made use of when they occur within a convenient distance.

LENGTH OF PUPAL STAGE.

The length of the pupal stage of the coconut caterpillar, as obtained at Georgetown, is from eleven to fourteen days.

Of a lot of forty pupae which pupated in March the pupal period varied from eleven to thirteen days with an average of 11.9 days. In two instances (5.0%) it was eleven days, in thirty-seven (92.5%) it was twelve days, and in one (2.3%) it was thirteen days. In another lot of eleven pupae in which pupation occurred in July the pupal period was also from eleven to thirteen days, with an average of 11.9 days; eleven days and twelve days in four instances (36.3%) each and thirteen days in three instances (27.2%).

PUPAL COLORATION.

A small percentage of pupae occurring under natural condition as well as of those in which pupation occurs in the laboratory differ from the normal pupa in colour. Such pupae instead of being a pale pinkish-lilac are of a light pea-green colour. This colour is to be seen often in pupae when pupation has only recently occurred, but changes in a short period. In a small proportion, however, this green coloration continues throughout the pupal period. In a few instances when such coloration has been observed and the pupae isolated no difference could be observed in the adult butterflies emerging therefrom. In some of the instances at least which have come under the observation of the writers this green coloration of the pupae appeared to be associated with environment.

WEIGHTS AND MEASUREMENTS OF PUPAE.

A number of pupae were measured and weighed and the frequency curves of the data are shown in Fig. 1. Statistical analysis of the data showed, however, that the differences were not significant although they appear to be suggestive. It was found during the course of investigations that there was a definite loss in weight during the pupal period and an attempt was made to determine the amount of such loss. 144 male and 121 female pupae were weighed shortly after pupation

FIG. 1.

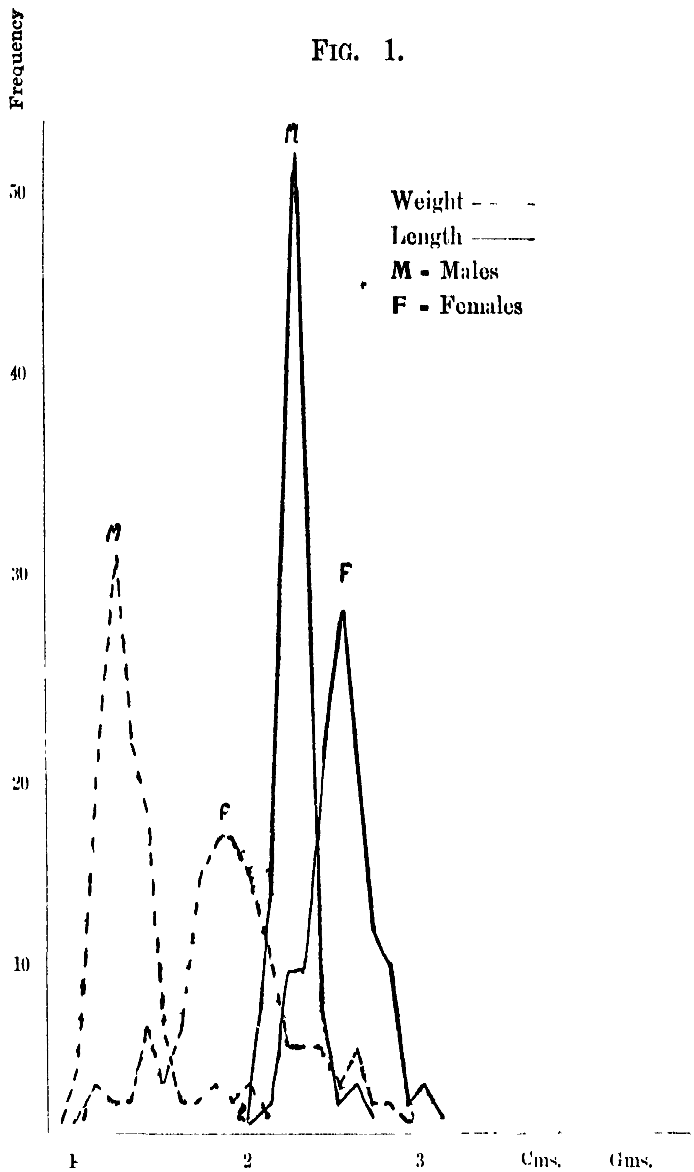


FIG. 1.—Diagram showing Frequency Curves of Weights and Measurements of Pupae of *Brassolis sophorae* L.

and again shortly before emergence. The mean loss of weight in males was 13.9 per cent., and that of the females 11.9 per cent. Fig. 2 shows the frequency curves of the data thus obtained.

FIG. 2.

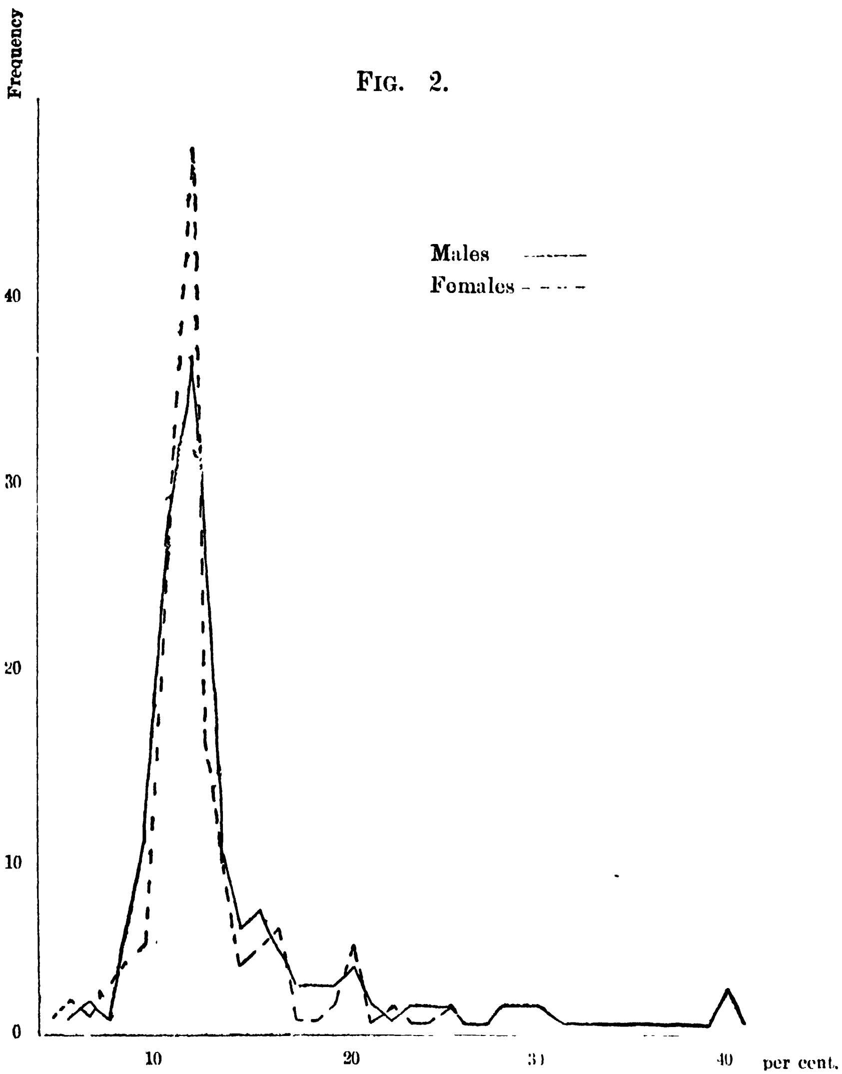


FIG. 2.—Diagram showing Frequency Curves of Loss in Weight of Pupae of *Brassolis sophorae* L.

ECLOSION.

The adult emerges by the pupa rupturing along the meson of the thorax, the margin of the wing cases and the outer margins of the antennae. During eclosion an opaque pink fluid flows from the pupae which emits a peculiar and characteristic odour.

This fluid is often exuded by the adult insect from its abdomen shortly after its emergence and before it has become thoroughly hardened. The deposit left by this liquid will retain its colour for several weeks, and even its scent for a considerable time after being voided.

THE ADULT.

(PLATE I, FIG. 1, TEXT-FIGS. 7 AND 9)

ACTIVITY OF BUTTERFLIES.

The butterflies are not active during the greater part of the day, but remain quiet and more or less concealed under the foliage of the palms or in vegetation

FIG. 3.

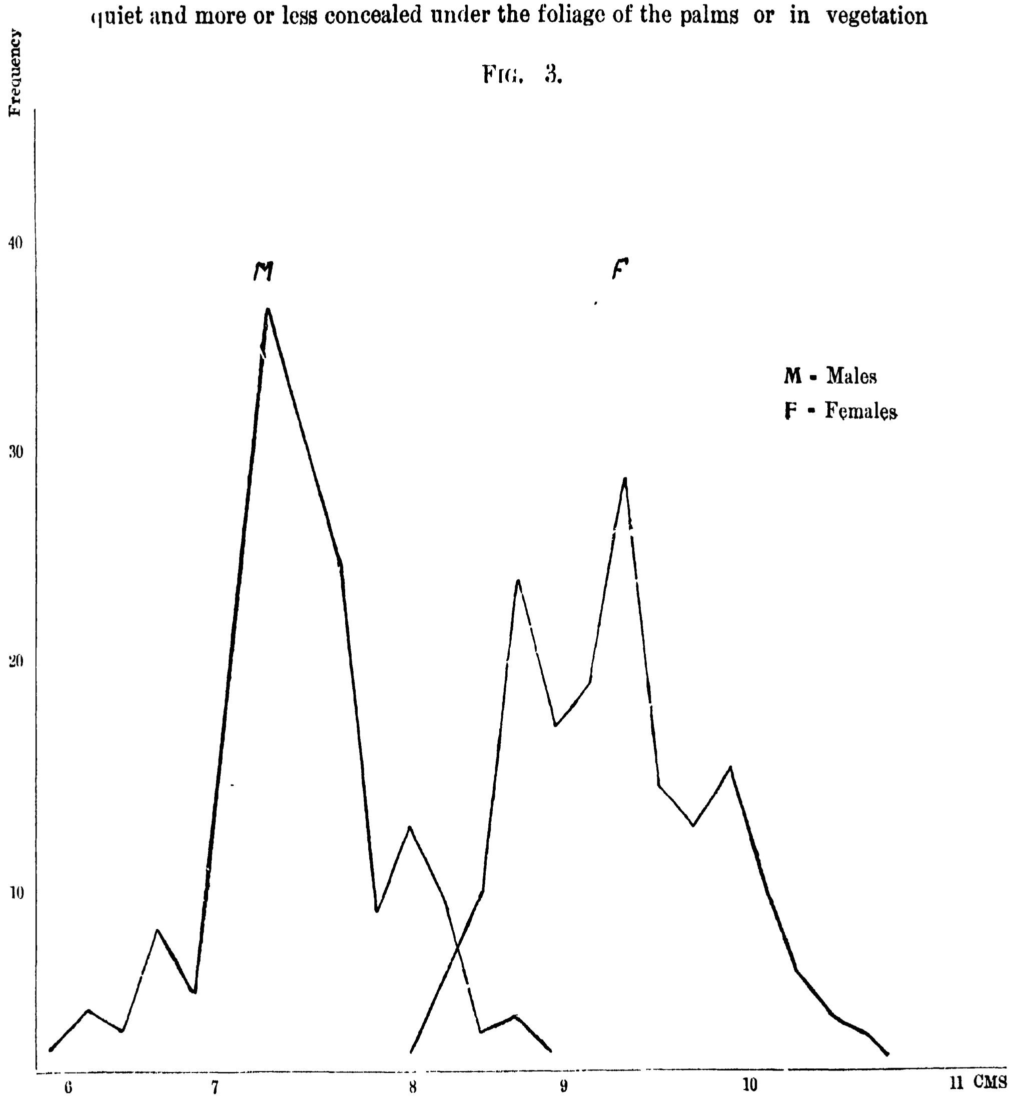


FIG. 3.—Diagram showing Frequency Curves of Wing Expanse of adults of *Brassolis sophorae* L.

growing in their vicinity. In the late afternoon, usually about 5.30 p.m., as the light begins to get dull, they become active, and as dusk approaches this activity becomes more marked. When the insects are abundant, as during occasions of outbreaks of the pest, they may be seen at such hour in large numbers flying feebly about. Mating occurs at this time.

MEASUREMENTS.

There is a marked difference in size between the sexes, the female being much larger than the male.

One hundred and fifty specimens of each sex were taken at random and wing measurements made and the frequency curves are shown in Fig. 3. The mean of the male measurements was 7.24 cm., with a standard error of 0.1393; the mean of the female measurements was 9.013 cm., with a standard error of 0.4255. The difference between means is 1.773. Sum of Standard Errors x 3 = 1.6944. The difference in size is therefore significant.

PROPORTIONS OF SEXES.

Both from observations in the field as well as from laboratory rearings of the insect it appears that the numbers of the sexes are about equal.

In six counts made on different occasions for the purpose of determining the proportion of the sexes, of a total of 888 individuals, 391 or 43.5 per cent. were males and 497 or 55.5 per cent. were females.

LIFE CYCLE.

The length of the life cycle varies somewhat and the result of laboratory rearings is given in Table 2.

TABLE 2.—Duration of life cycle of *Brassolis sophorae* L. at Georgetown, B.G.

	Minimum	Maximum
	Days.	Days.
Egg Stage	20	21
Larval Stage	60	100
Prepupal Stage	2	4
Pupal Stage	14	11
Total ...	93	136

TECHNICAL DESCRIPTIONS.

THE EGG. (PLATE I. FIG. 2.)

The egg is cylindrate-sphiroidal (cydariform), circular in cross-section, ivory-yellow* in colour with a central circular spot of puisard yellow* when freshly deposited, becoming darker as devolopment proceeds and finally mouse-gray.

*The colour names used in the descriptions are from Ridgway's Colour Standards and Nomenclature, 1930.

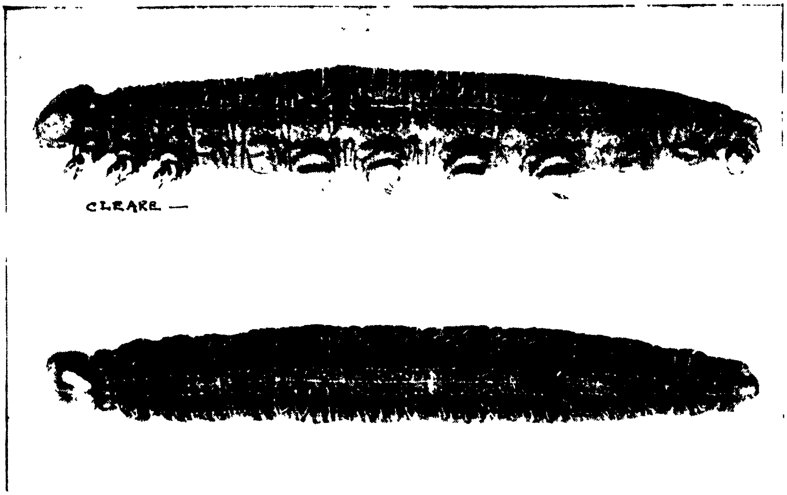


FIG. 1 —Larvae of the Coconut Caterpillar, *Brassolis sophorae* L. Lateral and Dorsal aspects. Slightly enlarged.

FIG. 2.—Pupae of the Coconut Caterpillar, *Brassolis sophorae* L. X1½ Ventral and Lateral aspects.

FIG. 4.—Full grown Larva of the Coconut Caterpillar *Brassolis sophorae* L. (About natural size.) Lateral aspect.

Exochorion smooth except for a ring of small shallow indentations extending around the top edge both dorsally and laterally. Height 1.5 mm. Breadth 1.3 mm.

THE LARVA (PLATE II. FIG. 1, AND TEXT-FIG. 4.)

Full grown Larva.—Head rounded triangular, slightly bilobed, claret brown in colour with two very dark almost black crescentic areas which sometimes cover the greater portion, clothed with short, soft hair, principally of a golden colour but some white, height 7.0 to 8.0 mm., width 6.3 to 6.8 mm. Body subcylindrical, tapering slightly towards both ends both dorsally and laterally, widest in the region of sixth, seventh, and eighth abdominal segments, dark seal brown in colour with lighter stripes of dresden-brown and fine stripes of cream colour on the dorsum extending along its entire length, vinaceous russet on the venter with a subspiracular band of neutral red. Nine stripes can be distinctly seen immediately behind the head, three situated dorsally and six laterally, but become less distinct as they extend backward. This is particularly so with the dorsal ones which become fused at about the first abdominal segment forming a broad band. In the lateral stripes the middle ones become considerably broadened but do not fuse with the others. All these colours are mottled to a greater or lesser extent with fine pale cream colour spots which produce somewhat varying hues and tints. The caudal part of each segment shows three or four transverse folds. On the first segment there is a dark spiracle, also one on each of the segments from the fourth to the eleventh. The entire body is covered with short, soft, white hairs. The larva as a whole has a somewhat "tartan" appearance. Length of larva 60.2 to 64.4 mm.

THE PUPA (PLATE II. FIG. 2, AND TEXT-FIGS. 5 AND 6.)

Short and stout without strong angles or protuberances, length about twice width, narrow at meso and metathoracic segments blunt anteriorly the front being almost at right angles to the ventral surface; abdomen rounded dorsally and bluntly pointed posteriorly, fourth abdominal segment capable of movement, pupa hangs suspended from a silken web by the cremaster.

The ground colour varies from a light viridine green* to a pale cendre green or a very pale vinaceous-lilac changing to a deep purplish vinaceous becoming later deep brownish drab and finally Prussian red. The ground colour at first

*The colour names used in the descriptions are from Ridgway's Colour Standards and Nomenclature, 1930.

may be either light viridine green or pale cendre green or a very pale vinaceous lilac, if of the green coloration this may later change to the vinaceous lilac or in some instances the pupa may retain this colour until the adult emerges. Five irregular strips of claret brown to burnt lake or diamine brown, varying in intensity from a pale hue to a very dark tint almost black, bordered on each side by a pale purplish white, extend the whole length of the body along the dorsal and lateral areas. Of these three are dorsal, of which the medio-dorsal is the broadest and best defined extending from the suture behind and extending from the metathorax to the eighth abdominal segment, these two lateral being broken on the second, third and fourth abdominal segments into irregular markings but continuing regular from the fifth to the eighth abdominal segments. There are two additional stripes of diamine brown on the venter of the abdominal segments (fifth to eighth), well separated on the fifth but gradually converging to the eighth abdominal segment where they meet the substentor forming as a whole a somewhat U-shaped marking. On the wing cases there are markings of diamine-brown as also on the eyes and the genae, while the clypeus and pilefers are also of this colour. The caudal portion of the fourth abdominal segment is smooth and devoid of marking, forming a flexible joint below which the abdomen is movable as a whole.

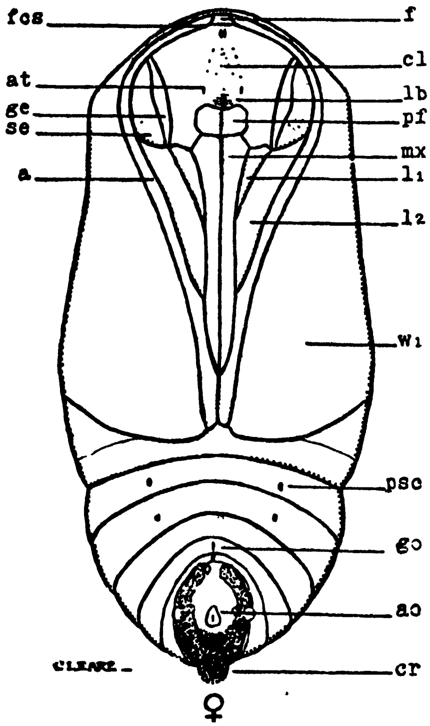


FIG. 5.—Pupa of the Coconut Caterpillar *Brassolis sophorae* L., showing its structure.

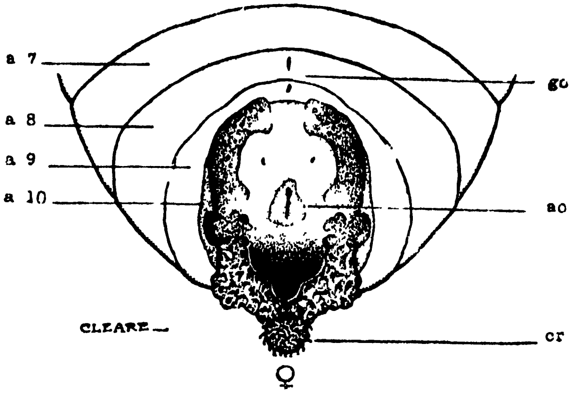


FIG. 6.—Terminal Segments of female pupa of *Brassolis sophorae* L. showing structure.

Labrum not distinctly separated from clypeus, quadrate; fronto-clypeal suture distinct; methathoracic wings reacting almost to caudal end of fourth abdominal segment; methathoracic wings not visible on the venter; pilifers large and meeting at the meson; maxillae reaching to about three-quarters the length of wings; prothoracic legs about one-third the length of maxillea; mesothoracic legs about two-thirds the length of maxillae; antennae not distinctly clubbed and extending almost to caudal margin of wings proximae ends extending almost to the meson on the dorsum of head; sculptured eye-piece somewhat broader than glazed eye-piece; invaginations of the tentorium arms distinct; mesal length of prothorax less than half that of mesothorax; caudal end of fourth and cephalic end of fifth abdominal segments smooth and devoid of carinations; proleg scars visible on fifth and sixth abdominal segments; spiracles elipsoidal very dark diamine brown; cremaster consisting of a number of short recurved hooks; genital openings of female slit-like, situated on the eighth and ninth abdominal segments; the ninth segment converging with the tenth to form a substentor ridge, the whole as it were encircling the anal opening; genital opening of male simple, slit-like situated on ninth abdominal segment.

Length 21.1—26.2 mm. Greatest width 10.0—13.4 mm.

THE ADULT. (PLATE I. FIG. 1, AND TEXT-FIGS. 7 AND 8.)

Male.—Head and face dark olive-gray with diffusions of orange-chrome to mars orange; labial palpi of same coloration; antennea diamine-brown. Thorax dark olive-gray with diffusions of orange-chrome to mars brown on the patagia; forewings very dark bone brown with a broad oblique band orange-buff at the anal end becoming lighter as it extends forward and finally a light buff at the costa and in this area there is a small brown spot at the base of M_2 which may be almost absent; base of veins and the anal margin suffused with orange-chrome and dark olive-gray; costal and distil margins concave; under surface buffy-brown

speckled finely with white about the apical area with a distal marginal wavy stripe, the edges of which are a dark bone-brown ; sub-apical eye-spot in cell M_1 of a dark bone-brown with pale buffy brown edge and a white central area comprising of a few fine scales; the oblique band being a light to pale ochraceous-buff. Hindwing dark bone-brown with sub-marginal distal band distinct and orange with edges of Hay's russet at the costa gradually spreading and darkening as it extends backwards to a broad diffused area of Hay's russet; base of veins and anal area suffused with dark olive-gray; under surface buffy-brown without distal marginal band, speckled finely with white over most of the area, three eye spots arranged, more or less triangularly with the apex distally and smallest and least defined, the others placed costally and anally, there may be also a rudimentary fourth spot situated between the costal and distal spots in all Rs.; eye spots buffy olive edged with dark bone-brown, the costal one being best defined, also some white scales within, narrowed anally and produced into an obtuse point. Abdomen Hay's russet dorsally, orange-chrome laterally and dark olive-gray ventrally. Legs dark olive-gray, first pair aborted and held folded, apparently non-functional. Genitalia, uncus a stout short simple hook; cucullus short and broad, and angles not well defined, sacculus large broad and triangular ; juxta composed of a ring around the aedoeagus with a number of spines.

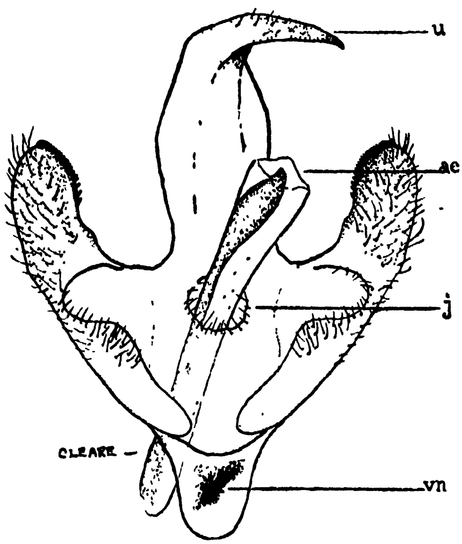


FIG. 7.—Genitalia of male *Brassolis sophorae* L.

FIG. 1.—Coconut palms showing damage caused by Coconut Caterpillar.

FIG. 2.—Coconut palms showing damage caused by the Coconut Caterpillar.

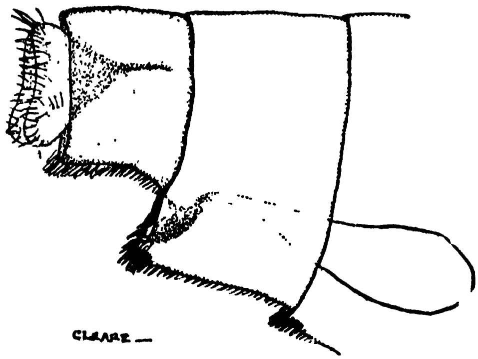


FIG. 8.—Genitalia of female *Brassolis sophorae* L.

Alar expanse 63.7 to 69.3 mm.

Female.—Oblique band on forewing orange darkening at its margins to cadmium orange and xanthine orange and Hay's russet, the browna area at the base of M_2 being much larger and extending from the costa for some way into the oblique band and making the band appear somewhat Y-shaped. Costal and distal margins convex ; under surface as in male but coloration more pronounced. Hindwing with sub-marginal band more distinct and more inclined to break up into spots in its cephalic portion ; underside may have in two additional and smaller eye spots situated one on each side of the large distal eye spot in the cells Rs. & M_2.

Genitalia as represented in Fig. 8.

Alar expanse 81.0—91.5 mm.

NUMBER OF GENERATIONS, SEASONAL HISTORY AND PERIODICITY OF OUTBREAKS.

It has been shown that the coconut caterpillar is capable of completing its life cycle in about three months (120 days), and assuming this to be the normal rate of development one may expect three generations of the insect a year. From observations in the field it would appear that this is what takes place and that new generations occur in March—April, June—July and October—December, which would coincide more or less with the wet seasons in April—May—July and November—January. Amongst the owners of coconut plantations it is recognised also that during wet seasons "caterpillars" are troublesome, and that during the dry seasons they are scarce. In addition it has been observed that outbreaks occur usually in years in which the rains are prolonged or when the seasons are not as well defined as usual owing to an abnormal distribution.

Besides this seasonal variation there appears to be a periodicity as regards outbreaks, for although the coconut caterpillar is to be found in greater or lesser numbers every year it is apparently at more or less regular intervals that out-

breaks occur. From the information available it would appear that such outbreaks or peaks of infestation occur at intervals of about five to seven years, but the insect may be present in fair numbers for a year or even two preceding and following these peaks.

In considering the periodicity of outbreaks of the coconut caterpillar it is necessary to treat each district separately, and indeed this would seem to be right, for it must be remembered that the different coconut areas in the Colony are, as a rule, well defined and separated from each other, and with the insect's feeble powers of flight infestation does not as a rule take place by the insects spreading from one area to another. The following dates of attacks of the coconut caterpillar in different parts of the coastal area will show this periodicity of the insect to some extent.—

Georgetown.—	1891.	1905.	1912—15.	1917—20.	1922—23.
	1927—30.	1933—34.			
Mahaica.—	1905.	1915—16.	1921—22.	1929—30.	1933—34.
Mahaicony.—	1909.	1917—19.	1922—24.	1927—30.	1932—33.

NATURAL ENEMIES.

A number of natural enemies have been recorded as attacking the coconut caterpillar at one or another stage in its life cycle. As has been stated previously, these natural enemies play a very important part in determining the prevalence of the insect, and to a very large extent determine the occurrence of outbreaks of the pest. Small local attacks may be controlled by natural enemies alone, and indeed, even when more extensive outbreaks occur it is often the natural enemies which must be considered as the principal agents in bringing about the control of the pest, and accomplishing much more than the efforts of man in this direction.

The most important natural enemies of the coconut caterpillar are insect parasites, and of these five species have been recorded, parasitizing the egg, larval and pupal stages of the insect, namely, two egg parasites *Anastatus reduvii* How., and *Telenomus nigrocoxalis* Ashm., one larval parasite *Chaetolyga pyrrhopyga* Wied, and three pupal parasites *Spilochalcis morleyi* Ashm., *Brachymeria incerta* Cress. and *Brachymeria annulata* F.

A number of predators have been recorded also as attacking the coconut caterpillar, and most important amongst these are several native birds, namely, the Kiskadee, *Pitangus sulphuratus*, the "Chima-chima" hawk, *Milvago chimachima*, the Old Witch, *Crotophago ani*, as well as the Bunyah, *Ostinops decumanus*, (C. Williams, Mahaicony 1930.) All of these birds have been observed feeding on the larvae, and in some instances have been seen to take the butterflies when opportunity occurred, the Kiskadee being especially noted in this respect. Domestic fowls and turkeys also have been observed on occasions to feed voluntarily on the larvae and butterflies, and in other instances when they have been fed to them to devour them readily.

In the laboratory the common red stinging ant, *Solenopsis geminata* F., has been observed to attack the caterpillars, but no such attacks have been seen in the field.

The larvae of *Brassolis sophorae* have been observed during outbreaks to be attacked by a fungus, probably *Metarrhizium anisopliae*, which is responsible for the death of a small percentage of this stage of the insect.

EGG PARASITES.

The egg parasites *Telenomus nigrocoxalis* Ashm. and *Anastatus reduvii* How. play a very important part in the control of the coconut caterpillar. Of these insects *Telenomus* is the more important, destroying a much larger number of eggs than the *Anastatus*. Several *Telenomus* will develop in an egg of *Brassolis sophorae*, and as many as five or six of these parasites have been observed to emerge from a single egg of the host, in addition *Telenomus* parasitizes a much larger number of egg-masses than does *Anastatus*, and during one outbreak at least it was definitely noted to have been responsible for the greater part of the egg-parasitism.

Squire (24) has shown that the life cycle of *Telenomus nigrocoxalis* occupies 14 days and that from five to six parasites develop in each egg of the host as the result of a single oviposition. The ovipositor is inserted in the side of the egg and about five minutes is required to complete oviposition. Prior to oviposition the parasite makes a careful examination of the host eggs, and apparently is able to determine whether parasitism has already occurred.

An idea of the value of these parasites, without differentiating between the two insects, may be obtained from some counts of egg-parasitism made during outbreaks of the pest. In a small outbreak which occurred in Georgetown in 1928, of 157 egg-masses, collected during April, 26 were completely parasitized (16.5 per cent.), 23 were partly parasitized (15.2 per cent.) and 108 were unparasitized (68.7 per cent.). Towards the end of an outbreak parasitism of the eggs may be very high, and during a recent outbreak a random collection of eggs made at such a time exhibited a total parasitism, about 91 per cent. of egg-masses, of this, however, about 21 per cent. of the egg-masses were only partly parasitized, in all the egg-parasitism was about 70 per cent.

LARVAL PARASITES.

Only one parasite of the larva has been recorded up to the present, and that is the Tachinid, *Chaetolyga pyrrhopyga* Wied. This insect while exerting a certain amount of check on the pest is not as important as either the egg or the pupal parasites.

Towards the end of the recent extensive outbreak in the Mahaicony District an effort was made to ascertain the percentage of parasitism due to this Tachinid. Of 1151 larvae and 29 pupae dissected between 18th February and 10th March,

1931, only 12 were found to be parasitized by *Chaetolyga* or about 1 per cent., while of a further lot of 906 (24.iii.31 to 6.v.31) 31 were parasitized by this insect, or 3.4 per cent. The mean of these two lots being 2.2 per cent. parasitism.

The number of Tachinids occurring in a single larva has been found to vary from one to four, and of 30 from which emergences were recorded there were 22 or 78.5 per cent. with 1 tachinid, 5 or 17.8 per cent. with 2 tachinids, and 1 or 3.5 per cent. with 4 tachinids.

The pupal period of *Chaetolyga pyrrhopyga* Wied. as observed in 17 flies varied from 9 to 13 days with a mean of 5.2 days.

PUPAL PARASITES.

Three pupal parasites have been recorded as attacking *Brassolis sophorae* in British Guiana, namely *Brachymeria annulata* F., *Brachymeria incerta* Cress, and *Spilochalcis morleyi* Ashm. (= *brassolis* Schrott). Of these *Spilochalcis morleyi* has been found to be the most important economically, and on the whole parasitizes a far greater number of the pupae, although at times *Brachymeria incerta* is more prevalent. In addition a far greater number of *Spilochalcis* develop in a single *Brassolis* pupa than the larger *Brachymeria*, and on one occasion as many as one hundred and twenty *Spilochalcis* have been obtained by the writers in a dissection of a *Brassolis sophorae* pupa, and in others eighty-five, eighty and seventy-two *Spilochalcis*, but from thirty to sixty *Spilochalcis* in a pupa of this host is common and appears to be the usual number. The greatest number of *Brachymeria* observed by the writers in a pupa of *Brassolis sophorae* has been twenty-nine, the more usual numbers being from six to twenty.

Brachymeria annulata F. has been recorded by Bodkin (3) as a parasite of *Brassolis*, but in outbreaks that have come under the notice of the writers *Brachymeria incerta* Cress. has been the species concerned.

Both *Brachymeria incerta* and *Spilochalcis morleyi* have been observed (C. Williams, 1930) to be attached to the flowers of "Black Sage" *Cordia ubletii* and of "Burra-burra" *Solanum* sp.

Of two lots of pupae collected during October 1931 from the Mahaicony District, and comprising of 31 and 141 pupae, dissections showed the total parasitism by *Spilochalcis* and *Brachymeria*, without differentiating between the two insects amounted to 34.3 per cent. and 23.4 per cent. respectively.

MEANS OF REPRESSION.

PREVENTIVE MEASURES.

Taken as a whole perhaps the most impressive feature of the coconut areas in the Colony is their generally unkempt condition and lack of any real cultivation of the crop. In attempts to control outbreaks of the coconut caterpillar it has been necessary in some instances to perform a considerable amount of "under-

bushing," which in reality amounted to clearing a miniature jungle at times, before many of the palms could be even approached. To ascribe a reason for this condition is not always easy, but at least a large proportion can be attributed to the fact that land itself in the Colony is too easily or too cheaply acquired, and individuals whose circumstances—and circumstances must be employed here in a wide sense—do not allow of their adequately maintaining but a small acreage, are in possession of holdings many times the size they can cultivate. In addition there appears to prevail in the Colony an idea that ordinarily a coconut cultivation requires no attention beyond the gathering of the nuts and an occasional weeding, the latter being performed only when it becomes a dire necessity, and then as an inevitable necessity rather than a recognition of its actual value, while insect pests —and in this respect it is the coconut caterpillar that is now principally referred to—are given not the slightest consideration until they have performed such damage that their work is the most conspicuous feature of the countryside.

It has been pointed out previously that there can be little doubt that outbreaks of this insect are to some extent brought about by injudicious agricultural practices, such as the accumulation of husks, leaves and other débris about the fields and especially the basis of the palms. The first steps to be taken, therefore, in general preventive measures is the discontinuance of such practices. If it is desired to incorporate such material in the soil it should be buried systematically in the field, or where this is not done it should be burned in convenient places where there will not be a danger of the palms being injured by fire.

In addition it is advisable to have a general look-out kept for any sign of damage by the insect as well. Usually long before an outbreak appears one may find individual "nests" of the caterpillars on isolated trees, and if steps are taken immediately to destroy these insects it is possible, usually, to nip in the bud what in a few months would develop into a serious outbreak. On one estate a method which was practised for a number of years with a good deal of success was a standing offer of a reward to any labourer who discovered and pointed out a "nest" of caterpillars and showed their presence on the estate at a time when the insect was not epidemic on the estate. In this way early notification of a potential outbreak of the insect on the plantation was obtained, and a small gang of labourers was immediately put on to destroy the caterpillars. Such prompt measures invariably resulted in the suppression of the insects, and the prevention of further damage.

Protection of Native Birds.

Certain birds are known to attack the coconut caterpillar in one or other of its stages, and encouragement should be given these birds on coconut plantations. The birds which have been recorded as destroying this insect are the common Kiskadee, *Pitangus sulphuratus*, a hawk, *Milvago chima-chima* (chicken hawk as it is known), the "Old Witch," Ani, or Tick Bird of the West Indian Islands,

Crotophaga ani, and the "Bunyah," *Ostinops decumanus*. With the exception of the hawk which is often destroyed as an enemy of poultry no active measures of destruction are directed against any of these birds in the Colony as far as is known, and there is legislation in existence which affords them a definite protection. It is desirable, however, that their usefulness in assisting in the repression of the coconut caterpillar should be generally recognised, and, particularly as regards the hawk, their destruction discouraged.

METHODS OF CONTROL.

The methods of control applicable to the coconut caterpillar in British Guiana under present conditions may be grouped under the heads (1) cultural, (2) artificial, and (3) natural. From a different point of view they may be classed as (1) those suitable to owners of a single palm or only a few palms, and, therefore, applicable to palms in towns and villages, and (2) those which can be adopted by owners of a number of palms and suitable to plantations.

Whatever measures are adopted a first essential in combating the pest is the early institution of control work. A delay of a few weeks in this direction often gives the pest an advantage which can be overcome only after months of work, the expenditure of several hundred dollars and the loss of a large proportion of the crop. It has been amply demonstrated that taken in time an outbreak of coconut caterpillar may be easily and completely suppressed at a comparatively small cost, and severe losses of crop avoided. Should the pest be allowed to get out of bounds great injury and devastation of palms may follow. Under such conditions all the measures of control set out below will have to be brought into operation, and even then the control of the insect will be brought about in all probability only after several weeks or even months have elapsed.

In towns like Georgetown and New Amsterdam, where coconut and other palms occur scattered throughout the house-lots and are owned by a number of individuals, or where, as in villages, an individual may own only a few palms, it is evident that only the simplest measures of control can be undertaken. The most practical method of combating the pest under such conditions, therefore, appears to be the simple removal and killing of the insects (Plate V.).

Under plantation conditions the control of an outbreak of the coconut caterpillar usually means the incurring of extraordinary expenditure, sometimes of a not inconsiderable sum of money, and owners are faced either with this or the alternative of a considerable loss of crop. Although alive to the damage resulting from an extensive outbreak of the pest owners may be unwilling, or unable, to incur the heavy expenditure and of the two evils choose, in many instances, the loss of thecrop especially if the market price of the produce is at the time low.

There are others again who are always ready with innumerable reasons why control measures cannot be adopted, and who usually evince a great desire to

FIG. 1.—Coconut palms with accumulations of husks, leaves, and other *débris* about their bases which afford suitable places for the pupation of the Coconut Caterpillar.

accuse neighbouring properties of harbouring the pest, and actually causing their lands to be infested. In such instances it has been observed usually that had the same amount of interest been shown with regard to the spread of the pest on their own property it would not reach the deplorable condition which it usually attains. Happily this attitude is passing as the result of long and continuous efforts against the pest, and with each successive outbreak more interest is shown and greater efforts made to bring the insect under control.

The control of the pest under these conditions must, therefore, be considered from a different angle, and becomes a question of adopting measures which must not only be efficient in themselves but also economical in cost and labour.

The difficulties attendant on the use of insecticides on this crop under local conditions, and the expense of applying them, at once rules this type of control out of consideration at the present time.

Hand-collecting, while expensive, cannot be neglected, and in fact must be undertaken under present conditions, and forms the basis of the work of natural control by the conservation and utilization of the parasites of the pest which should augment other control measures. In addition, by the institution of proper field practices and field sanitation much damage may be prevented.

CULTURAL MEASURES.

Field sanitation and proper field practices will go a considerable way, if not actually in reducing the damage caused by the insect, in making the application of control measures easier and cheaper in execution.

In previous sections dealing with the causes conducive to outbreaks of the pest and with preventive measures some consideration has been given to this aspect of the subject, and it will be necessary only to state here the desirability of discontinuing these undesirable practices wherever possible.

As an instance where cultural measures may actually serve to reduce to some extent the damage caused by the pest one may cite the practice of allowing accumulations of husks about the bases of the palms.

ARTIFICIAL MEASURES.

HAND-COLLECTING.

The habit of the caterpillars of collecting together and forming "nests," or of hiding in the "heart" of the palm during the day, renders hand-collecting of the insects a comparatively simple undertaking. But in undertaking such work the methods to be adopted by owners of a few palms, or in towns or villages, are somewhat different from those which should be used on plantations.

In the first instance to carry out such work boys should be employed to ascend the palms and remove completely all affected branches and "nests" and at the same time search the "heart" of the palms for caterpillars, which should be removed and destroyed.

The caterpillars and chrysalids thus obtained may be killed by any suitable means, a very effective method being the immersion of them in a strong mixture of kerosene oil and water, or disinfectant fluid (Carboleum, or "Jeyes" fluid) and water. When dead the caterpillars should be burnt, or buried and covered with not less than 18 inches of well-trodden earth, as is most convenient.

Individual owners of palms may, and sometimes do, experience difficulty in finding persons willing to undertake this work at reasonable charge during an outbreak of the pest, for as in all other matters it is the question of supply and demand that regulates the prices asked. When, as sometimes occurs in towns, the occupier of the premises is not the owner of the palms, and the owner himself gains no benefit by their possession, it can be understood that there is little inclination on the part of either to spend money in control measures. But if it is remembered that when a palm has been severely attacked and practically defoliated there follows a loss of at least one complete crop of nuts, the desirability of undertaking such work becomes evident. With the work properly organized it is possible to clear palms of the pest at a comparatively small cost per pálm, and in an outbreak of the pest in Georgetown some years ago, the Entomological Division was able to do such clearing at a labour charge of 12 cents per palm, but the price demanded for persons offering themselves for this work is usually somewhat in excess of this figure.

On plantations, from the very conditions which exist, the work of hand-collecting when adopted must be altogether more elaborate.

On the first appearance of the pest the systematic collection of eggs, caterpillars, and chrysalids should be immediately undertaken. Gangs of labourers, under the supervision of individuals who are acquainted with the different stages of the pest, should be organised and should be sent through the plantation systematically collecting the various stages of the insect, the numbers of such gangs depending on the extent and severity of the attack, but in any gang the number of individuals under each foreman should not be more than can be carefully supervised, probably not more than twenty labourers. In practice it may be found more convenient to divide the gang into small working parties and to allot different tasks to the individuals. Thus some individuals will be engaged in clearing an area of several feet radius under each palm in order to prevent the escape of caterpillars that fall during the clearing of the palm, others, with tins, or other receptacles, in receiving the insects thrown down by the climbers and in searching the trunks of the palms and débris for the different stages of the insects, while still others may be employed to climb and search the palms thoroughly and remove the insects. In addition it may be desirable at times, depending on the prevalence of the adult insect, to employ a few boys with nets to catch the butterflies that are to be found about the shady places and which may or may not be disturbed in the cleaning operations.

As an additional measure the butterflies may be collected at dusk at which time the insects are on the wing. In this instance it is usually best to pay for the work by results.

In order to perform this work satisfactorily it may be necessary, especially on plantations where a heavy undergrowth has been allowed to spring up, to carry out a preliminary weeding or underbushing so that any insects which may fall to the ground during the work of collecting will be secured. Or where accumulations of husks, leaves and other débris have occurred it may be necessary even to undertake preliminary burning of such detritus in order to perform efficiently the work. Should burning be necessary great care must be exercised to keep the flames in proper control, for failure to do so may result in severe injury to the palms from fire.

NATURAL OR BIOLOGICAL MEASURES.

Conservation and Utilization of Parasites.

The utilization of the insect parasites of the pests in the control of outbreaks offers a most effective method of control to be adopted against the coconut caterpillar. As practised by individuals this method is suitable only where the owner possesses a number of palms, and, therefore, on small or large plantations. It may be possible, also, to utilize the measures when outbreaks occur in towns and villages but under such conditions it would probably need to be undertaken by either Government or Municipal authorities, but this aspect of the subject will not be dealt with here.

On plantations where the conservation of parasites is to be practised the aid of the Government Entomologist should be obtained to plan and organise the work. It must be emphasised that to obtain satisfactory results from such work and to overcome the difficulties which will arise from time to time, the frequent supervision of an entomologist is necessary. Scrupulous cleanliness is an essential also if the work is to be successful.

The first necessity will be to detail an intelligent individual to take charge of the routine operations in connection with the work. Certain individuals show an aptitude above others for such work, and wherever possible the selection should be such a person.

As regards the actual operations the first step must be the discontinuance of the indiscriminate destruction of the eggs, caterpillars and chrysalids collected by the gangs, for these are the materials from which the parasites will be obtained. The keeping of these stages and the allowing of any parasites they contain to emerge and be returned to the fields to continue their useful work of destroying the pest is the basis of the work or the conservation of parasites. In this way the parasitism of the pest can be greatly augmented, and the control of the insect quicker brought about.

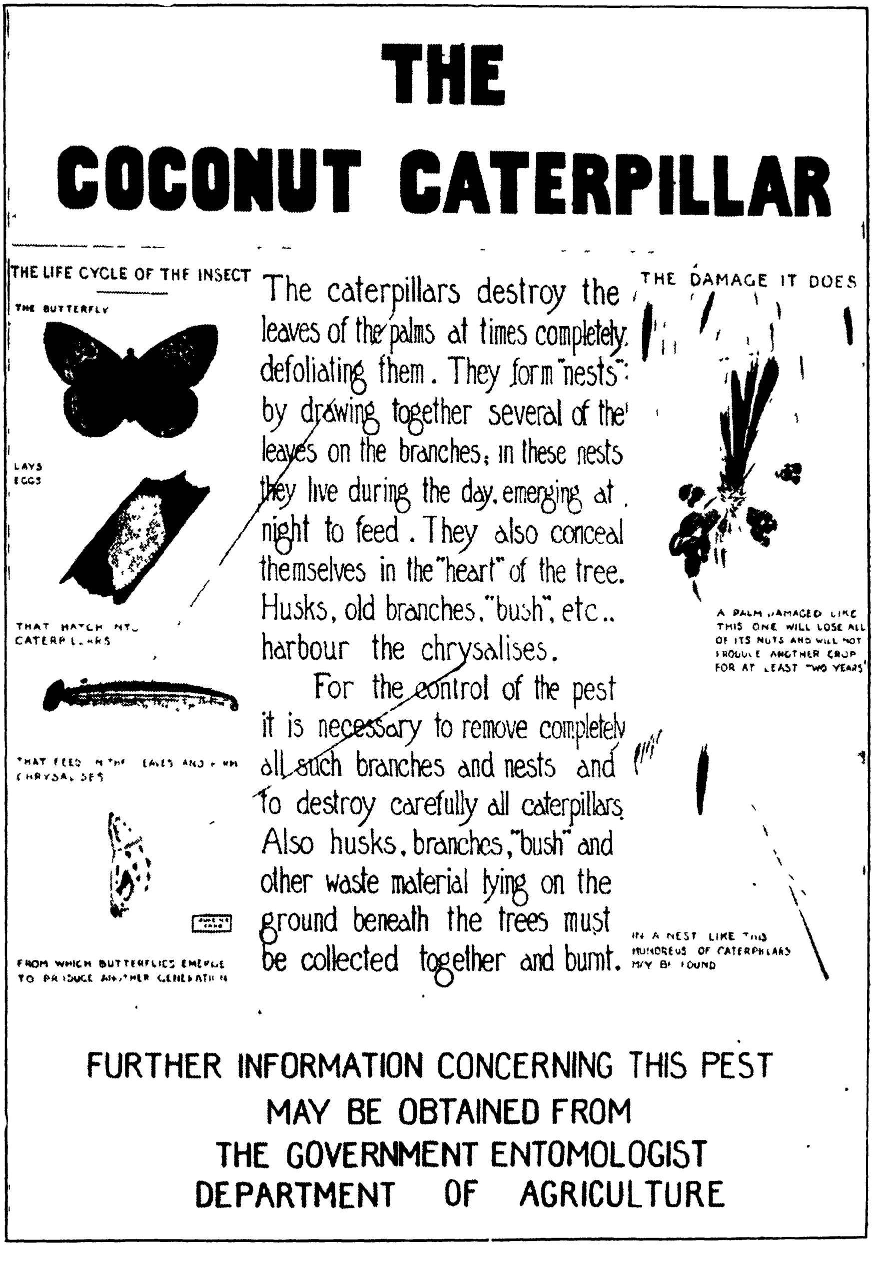
A collection of the different stages having been obtained it is necessary to deal with them so as to obtain the desired parasites. In order to accomplish this the different stages of the insects must not be crushed or injured in any way, and any that have been so injured must be discarded. Also the different stages must be kept separate, as far as possible, when collected in the field or it will be necessary to separate them after the day's collection has been completed. With the pupae all that is required after this is to place them on damp sand in trays in the parasite boxes, a description of which is given later, and when the parasites emerge to return these to the fields. With the caterpillars, however, it is only the fully grown ones which are about to change to chrysalids that are utilized, and for this reason it is necessary first to select from the day's collection those caterpillars of suitable development and to destroy the remainder. The selected caterpillars are then placed in a dark box and allowed to pupate, and when the pupae are formed they are removed and placed in the parasite boxes.

Egg-masses should likewise be kept separate, and placed in different boxes from those containing pupae. Pieces of young green coconut leaf should be placed in the trays along with the egg-masses as these serve to attract any young caterpillars which emerge from eggs which have escaped parasitism, and facilitate in their removal from the boxes.

The size of parasite boxes to be utilized depends on the severity of the outbreak and numbers of the different stages of the insect that are secured, the principle involved is the same, however, and it must be understood, therefore, that hard and fast dimensions cannot be laid down and that the size of boxes is subject to modification at the discretion of the entomologist who plans and directs the campaign.

It is advisable even in severe outbreaks, not to make parasite boxes of a very large size, but rather to depend on a multiplicity of smaller size boxes. In this way the number of boxes may be varied as the pest increases or decreases or for any other reason thus allowing more convenient working, and also should it be found necessary they are more easily moved to different parts of the plantation. It is more convenient when working with a number of boxes thus to place them on some stand or rack of convenient height. Protection against ants is, of course, essential, either by attaching legs to the boxes, if they are of the large size, and standing these in suitable receptacles containing water and kerosene oil or disinfectant fluid, or by protecting the stand in a similar way if smaller units are in use. For most purposes the ordinary kerosene case made to hold two 5-gallon tins and measuring about 27 inches by 33 inches by 10½ inches will be found to be a suitable size for parasite boxes, but both smaller and larger sized boxes have been used successfully in outbreaks.

The parasite boxes should open at the back, and be fitted with trays to slide in like drawers on runners made of pieces of wood nailed to the sides. These trays should be about two inches deep. The back of the boxes should be closed with a tight-fitting cover. In the front of the boxes there should be made cir-



Coloured Poster prepared by Mr. L. D. Cleare.

cular holes in which are inserted glass receptacles for the reception of the parasites. In small size boxes flat bottomed glass tubes will serve quite well for this, but where the amount of material dealt with is large, and the boxes somewhat bigger, 1 or 2 lb. jam bottles have been found suitable receptacles for this purpose. When jam bottles or similar wide-mouth bottles are used in the boxes containing pupae it is necessary to screen the holes in which the bottles are inserted on the *inside* of the box to prevent any butterflies which emerge from entering the bottles along with the parasites, and for the purpose galvanised wire-mesh of ¼ inch mesh is suitable. The boxes should be well made and the covers tight-fitting so as to exclude light, except through the bottles, and prevent the egress of parasites. Any parasites which emerge will enter the glass receptacles which may be removed subsequently and taken to the fields and released. Parasites should be released daily.

It is almost unnecessary to add that the number of parasite boxes should be increased to cope with the insects collected as the necessity arises. At any stage of the operations should the collection of insects become excessive and resort is taken to destroying them rather than increasing the number of the parasite boxes, a considerable number of parasites may be destroyed at a time when in all probability it would be most important that they should be preserved, and in this way the control of the outbreak delayed if indeed the pest not actually favourably affected.

The parasite boxes should be examined daily, and any butterflies that have emerged within destroyed. In doing this care must be taken to prevent the escape of the butterflies. For this purpose the backs of the boxes should be hinged so that they open downwards and a "sleeve" of mosquito net attached around the exterior of each box. If these "sleeves" are made the full size of the box for their entire length and of a length of about one-and-a-half times the depth of the box and the open end closed by means of a draw tape or elastic, it will be an easy matter not only to admit a hand and arm and remove any butterflies or pupae and egg-masses from which parasites or caterpillars have emerged, but the trays containing the material within the boxes may be manipulated and removed when necessary without difficulty. When the boxes are closed the "sleeves" will hang loose behind the back and can be tied out of the way.

Each day's collection of the pest should be dated and kept separate for a period of twenty days, after which time any remaining material may be destroyed.

An alternative of the method given above is, of course, the placing of boxes containing the collected material directly in the fields. In this method the sides of the boxes are screened with mesh of a suitable size which, while allowing the escape of the parasites as they emerge is fine enough to retain any butterflies which may be within. It is necessary also to protect these boxes in the fields against weather, ants, etc. Experience has shown, however, that such boxes placed in the fields are liable to interference by labourers, besides requiring more supervision, and for these reasons are not to be recommended for general use.

SUMMARY.

The Coconut Caterpillar, *Brassolis sophorae* L., is the most damaging insect of this crop on the coastlands of British Guiana.

It has been known to occur in the Guianas (Dutch) since 1705, and Linnaeus' name-type came from Guiana. Its distribution, systematic history and synonymy are given.

The economic importance, the nature of injury caused by the insect, and the causes conducive to outbreaks are dealt with, the known food-plants and the life history and habits are discussed. The egg, larva, pupa and adult are described. The natural enemies of the insect also are dealt with.

Means of repression and control measures are given, which include cultural measures, artificial measures, such as hand-collecting, and natural measures, the conservation of parasites.

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CATTLE ON THE COAST.

BY

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The remarkable hardiness of creole coast cattle and their freedom from disease combined with the fact that they can be kept almost without cost has tempted many peasant farmers, landowners and other country residents to own cattle. In the coast districts all available pasture is heavily stocked, and in the neighbourhood of large villages over-stocked. That these pastures supply feed sufficient for even the bare existence of the number of animals carried is extraordinary. The hardships and privations which the cattle suffer during a year are beyond the endurance of any other than creole stock.

Residents of the Colony are so accustomed to seeing cattle of inferior type in poor condition that they accept them as normal. On the other hand, visitors are surprised at the type of cattle kept, and appalled by the conditions under which they live. Cattle-owners accept the conditions as normal either because they have no knowledge of live-stock or because they have no consideration for their animals. The conditions are decidedly abnormal, and the poor type of animals is due to the environment in which they are forced to live; in seeking a few cents profit from the sale of milk both the cattle and the land are highly abused. A fifty per cent. reduction of the number of cattle on the coast would be an advantage. The common argument in favour of country residents owning cattle is that the majority are poor men and require milk for their families. The argument is not sound; the original price of a cow amounts to dollars which would purchase milk at present prices for a lactation period and leave a surplus in hand. The real reason for keeping cows is the hope of making a few cents by selling milk.

Most cattle-owners are not poor men in a comparative sense, and in any case no man has a right to keep animals for his benefit under conditions which amount to cruelty. In the intensely cultivated areas there is no more room for cattle than there is in the centre of the city. There is no sensible argument which can be advanced in favour of allowing cattle-owners to use waste lands where cattle can obtain a mere existence diet from coarse herbage unless the lands are used merely for exercise and the animals are properly fed in stables.

Many cow-keepers when told that they are starving their animals consider the absence of grazing facilities ample excuse. It is not an excuse which can be accepted in that if owners cannot provide proper facilities for feeding they have no right to keep cattle. The peculiar conditions of land settlement make mixed

farming impossible for peasant farmers, and, in these circumstances, as all the good land is required for cultivation, cattle should be moved farther afield or be kept in stables.

Improved conditions under which cattle can live on the coast pastures can be obtained only by reduction of the number kept, and unless the reduction is made the conditions will become worse. The first step necessary is placing all cattle inside wire fences or in stables. This will be a costly operation, and land-owners will naturally adjust their agistment fees to meet the expenditure. Cattle-owners will find that many of their animals are not worth agisting and will need to dispose of them. The only method of disposal is sale for butchery at whatever price they will fetch. This will further depress the meat market temporarily but it cannot be avoided.

The next step will be the selection of female stock for breeding purposes. Animals not selected for this purpose should be segregated and run without bulls until they can be disposed of in the meat markets. Bulls should then be selected and those not approved should be castrated. The reduction by the elimination of the more inferior stock should be continued until the number of animals remaining is no greater than can be safely carried by the available pastures in normal years. At this stage it probably will be found that the average pasture will carry improved stock if both animals and pasture are properly managed.

The next step should be the introduction of pure-bred bulls suitable for the area. To provide funds for this expenditure it is suggested that a levy of 1 cent per lb. should be imposed on all meat consumed in the Colony. At present prices an increase of 1 cent per lb. can be easily borne by the consumer.

The fact that the meat supply of the Colony is of inferior quality cannot be ignored; the best that can be said for it is that it is cheap. With a reduction of cattle and improvement of breed it will be an easy matter to keep the meat and milk markets fully supplied with superior products and have a surplus number of cattle for export.

Theoretically the Colony can be divided into zones for the raising of different breeds of cattle, milk, dual purpose, and beef. In practice, the cattle population is moving in this direction, but there is no sound classification of type and only slight change in management.

MILK BREEDS

The chief milk market is Georgetown, and, in the absence of cheap and rapid transport, it is necessary to keep milk cattle within a certain radius of the city. When facilities for cooling of the milk and rapid transport are available it will be possible to extend the area.

At the present time the milk producing area may be defined as East Demerara as far as Mahaica, West Demerara including the island of Leguan, and the East and West Banks of the Demerara River. These are closely settled areas and the amount of pasture available is very limited. Milk cattle in these areas should consist of improved breeds which will pay if stall-fed. At the moment a cow of any type is considered a milch cow; many of them yield only sufficient milk to rear their calves, but the milk is drawn and sold and the calves are starved. Stall-feeding these animals with cut grass and concentrates is a waste of time and money. For profitable milk production and the breeding of improved or grade animals it is advisable to select foundation creole stock yielding not less than 14 to 15 pints daily.

A scarcity of grass in these intensely cultivated areas is unavoidable during certain seasons. The seasons are normal, and preparation can be made for them: fodder plants and grasses can be grown. Guatemala Grass amongst which *Phaseolus semi-erectus* has been sown, Demerara Primrose and *Alysicarpus vaginalis* (locally known as horse-weed) planted amongst Guatemala Grass, and Para grass cut at an earlier stage than is the general custom, all grow luxuriantly on the Coast and are valuable forage. A concentrate mixture, as previously recommended, is inexpensive.

DUAL PURPOSE BREEDS.

Outside what has been designated the milk area, more pasture is available but requires conservation. Most cattle-owners of the Coast are East Indians and are not interested in the production of purely beef cattle. Those who are not interested in dairying alone require cattle which will produce a certain quantity of milk, and expect the male progeny to become beef or working oxen. Generally, all cows are expected to give a daily profit, and whether their male off-spring become well grown and developed working or beef-oxen is of secondary importance. On the whole the results are poor both in quantity of milk and quality of oxen.

In theory these areas are suitable for dual purpose breeds, but in practice it is probable that the increase of milk of the improved breed will at first be of no benefit to the calves. Experience may teach the owners that an improved type of cattle cannot be reared on the minimum amount of milk allowed to creole calves. When this fact has been learned, it is possible that the cattle-owners will be content with an improved milk yield and the profits from selling beef and working oxen of quality.

It is to be expected that the progeny of dual purpose bulls and creole cows will live on the pastures without requiring supplementary rations, provided overstocking is avoided.

Milk production in the dual purpose area will cost less than that in the milk area, but the transport on account of distance from the milk market will cost more. The sale of milk will depend on cooling facilities and will need to be

wholesale, whereas milk producers nearer the city may be able to sell retail. But this latter disadvantage is off-set by the profits to be made from the sale of superior beef and working oxen.

There are a few areas suitable for ranching on a small scale, but this is not a branch of animal husbandry which can be practised without considerable capital, and it is not an attractive form of live-stock keeping for most of the coast cattle-owners who desire to live in villages and sell milk.

FISH POISON PLANTS OF BRITISH GUIANA

(A Preliminary List)

BY

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To enter a strange country in search of specific kinds of plants is scarcely a venture that will succeed easily without the assistance of the local authorities. In British Guiana the writer found a degree of co-operation that smoothed away all the difficulties which usually beset a newcomer. Capt. F. Burnett, the Acting Director of Agriculture in this respect proved such a valuable ally that, four days after arrival in the Colony, the writer, in the company of Mr. N. Persaud, an Assistant of the Department of Agriculture, had started on the first trip to the North West District. Here again Mr. A. W. B. Long, the Commissioner of the District, and the Agricultural Officer of the Hosororo Experiment Station, arranged matters with such dispatch, that the labour of months was condensed into a fortnight. The same was true later at Mazaruni Forestry Station under the guidance of Mr. T. A. W. Davis, the Acting Conservator of Forests. To this same gentleman is due much credit for assistance in the identification of many of the plants.

The main objective was the accumulation of plants used to poison or stupefy fish by the aboriginal peoples. A compilation [1] of published lists indicated that approximately 150 species of plants are used for such purpose in South America. Examination of the Jenman Herbarium at Georgetown and the Forestry Department collection at Mazaruni Station indicates that at least half of these plants are to be found in British Guiana. However, only a comparatively few are definitely known and used as fish poisons in the Colony.

Furthermore the same species are not used generally throughout the Colony; on the contrary, plants known as fish poisons in one district may be unknown as such in another part. This is especially true of the indigenous or wild-growing species.

The cultivated fish poisons are rather generally distributed. Of these, the best known is perhaps "Black Haiari" *Lonchocarpus* spp. [2] The Department of Agriculture has made experimental plantings at Hosororo of this species as well as of

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[1] Killip, E. P. and A. C. Smith—South American plants used as Fish Poison (In press.)

[2] Complete scientific names cannot be given in all cases in this report. Herbarium collections must first be checked with authentic specimens. One of the objectives at present is to secure adequate material that the identity of the fish poison plants may be definitely established.

the "White Haiari". "Conuparu" *Euphorbia cotinoides* Miq. is cultivated rather widely but meets with disfavour in that the sap is poisonous to man, and especially so to the eyes. A red-leaved *Euphorbia* is reputed to be even more poisonous than the common one. More favoured in cultivation are "Yarroconali" *Tephrosia toxicaria* (Sw.) Pers. and "Conami" *Clibadium* spp. Less often cultivated are species of *Phyllanthus*. The Botanic Gardens apply the name of "Dakanani" to *Phyllanthus* but there seems to be no agreement upon this, since in various localities are used other names such as "Conaparu", "Parapara" and "Spanish conali".

The more important of the wild species are :

"Abaho"=probably *Serjania paucidentata* DC. used in Mazaruni area.

"Casire"=*Serjania pyramidata* Radlk. used in N. W. District.

"Hebichiabo", "Kotupurru"=*Serjania* spp. used in N. W. District.

"White moruballi"=*Talisia squarrosa* Radlk.

"Black moruballi"=*Talisia* sp.

"Haiariballi"=*Alexa imperatricis* (Schomb.) Baker. The Haiariballi of the North West District is erroneously reported as *Muellera moniliformis* L. f.

"Inyáku"=*Antonia ovata* var. *pilosa* (Hook.) Prog. is said to be used by Wapisiana Indians of the Rupununi District, according to Mr. Davis.

"Teterumaballi"=*Jacquinia* sp.

"Arumatta"=*Clathropis bracypetala* (Tul.) Kleinh. In the N. W. District a tree by this vernacular name is said to be a fish poison, while in the Mazaruni section the tree by this name has been identified as indicated above, but is not known there as a fish poison.

"Hikuritarafón"=*Bauhinia guianensis* Aubl., used in the N. W. District.

"Warakabakoro", "Toná"=*Piper* spp., the leaves of which are used with *Clibadium* spp. by the Caribs of the N. W. District.

"Duburibanato"=*Pothomorphe peltata* (L.) Miq. mixed with *Clibadium* spp. as a fish poison.

There are several species of wild *Lonchocarpus* namely "Fai faia noroko"=*L. rariflorus* Mart., "Wakarocoda", "Red Hariari" and others collected under the general term of "Haiari". All are reputed to be less effective than either black or white "Haiari".

Many other species of plants occur in British Guiana but seem not to be known there as fish poisons. Of these the principal ones are :

Abuta imene (Mart.) Eichl.
Andira inermis HBK.="Kuraru", "Bat seed".
Andira retusa (Poir.) HBK.

Bowditchia virgiliodes HBK. = "Mak."
Byrsonima crassifolia (L.) DC. = "Hicha."
Caryocar glabrum (Aubl.) Pers. = "Kula", "Water sawari".
Cassia alata L. = "Carrion crow bush".
Cassia hirsuta L.
Centrosema plumieri (Turp.) Benth.
Cissampelos pareira L. = "Wild yam."
Cleome spp.
Clitoria arborescens Ait.
Clitoria guianensis (Aubl.) Benth.
Cusparia trifoliata (Willd.) Eng.
Derris guianensis Benth.
Desmanthus virgatus. (L.) Willd.
Gustavia angusta L. = "Lanaballi".
Hura crepitans L.
Ichthyothere terminalis (Spr.) Blake
Jacaranda copaia (Aubl.) D. Don. = "Simarupa".
Jatropha curcas L.
Macrolobium acaciaefolium Benth.
Paullina spp. = "Bread and cheese".
Polygonum spp.
Tapura guianensis Aubl. = "Waiaballi".

Of these species apparently *Clathropis bracypetala*, *Talisia squarrosa*, *Antonia ovata* var. *pilosa* and *Alexa imperatricis* have not been mentioned in previous lists. Further investigation should disclose other new plants or at least it should extend the distribution of fish poisons not hitherto reported for British Guiana.

THE PRESENT CANE VARIETY SITUATION IN BRITISH GUIANA.

BY

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The sugar estates of the Colony have kindly supplied the Department of Agriculture with statistics of the areas reaped and yields secured from different varieties during 1933, and also with data as to the areas under several varieties for the 1934 harvests.

YIELDS IN 1933.

It is unfortunate that all estates could not give the returns from Plant Canes, First Ratoons, etc., separately. Table I, below, summarises the yield data for 1933 from those estates which made the separation. Not all the varieties mentioned in the returns are included, but those omitted represent a very small proportion of the area reaped and, in most instances, are not canes likely to be extended. The separation into frontland soils and pegasse soils is not very rigid, for some estates did not divide their returns as to soil type although it is known that they reaped canes from both frontland and pegasse areas. In consequence, while the yields noted under "pegasse soils" were actually obtained from such soil, those under "frontland soils" include some results from pegasse areas. Since, as a general rule, pegasse soils do not yield as heavily as frontland soils, the inclusion of results from the former among those from the latter tends to make the frontland soil yields appear too low. Attention is drawn to these facts not by way of criticism of the returns, but merely to avoid misconception in the interpretation of the data presented in Table I.

It will be seen that the standard cane, D. 625, has been heavily outyielded by the seedling Diamond 10, although the latter was reaped mainly in the County of Demerara where yields are usually lower, while D. 625 had in its favour the higher yields normally secured on the Berbice estates. As was indicated by the variety trials reported in *Sugar Bulletin No. 3*, the advantage of Diamond 10 lies largely in its ratooning power. On the frontland soils, D. 625 produces as a first ratoon 78 per cent. of its plant cane yield, while its yield as a second ratoon is only 65 per cent. of that given by the plant canes. The corresponding figures for Diamond 10 are, respectively, 89 per cent. and 80 per cent.

On the comparatively small areas reaped, S.C. 12 (4) proved slightly inferior and B.H. 10 (12) slightly superior to D. 625. They are both well below Diamond 10 in total yield for three crops.

TABLE I.—WEIGHTED MEAN YIELDS OF 96^{c} SUGAR PER ENGLISH ACRE FROM THE MAJOR VARIETIES GROWN IN BRITISH GUIANA IN 1933.

		Frontland Soils.							Pegasse Soils.			
		D. 625.	Diamond 10.	S.C. 12 (4).	B.H. 10 (12).	D. 118.	P.O.J. 2878.	Mixed.	D. 625.	Diamond 10.	B.H. 10 (12).	Mixed.
Plant Canes	Acres Reaped.	6.900.5	2,286.3	73.2	155.6	366.7	18.9	2,548.6	1,086.2	299.0	8.3	1,116.2
	Yield of Sugar per Acre, Tons.	3.55	3.67	3.66	3.68	3.00	4.06	2.93	3.45	2.98	4.00	2.17
First Ratoons	Acres Reaped.	6,972.5	1,575.3	36.6	129.7	405.3		2,427.5	521.9	18.9		1,615.3
	Yield of Sugar per Acre, Tons.	2.76	3.28	2.92	2.52	2.11		2.12	2.36	5.35		1.84
Second Ratoons	Acres Reaped.	6,090.8	929 5	2 3	239.7	544.2		1.762.2	509.5			974.6
	Yield of Sugar per Acre, Tons.	2.32	2.95	1.76	2.60	2.06		1.99	2.27			1.56
Three Crops; Total yield of Sugar per Acre, Tons:		**8.63**	**9.90**	**8 34**	**8.80**	**7.17**		**7.04**	**8.08**			**5.57**

D. 118 covers a considerable area in West Demerara and along the banks of the Demerara river. Its yields are much inferior to those of Diamond 10 or even D. 625 and it should be eliminated as rapidly as possible.

There are still large areas on the estates planted to varieties indiscriminately mixed together. The columns headed "Mixed" in the Table above are an obvious and definite condemnation of the practice. The solution of the problem is not difficult; it lies in the establishment of nursery areas of pure stands to be "drawn down" and used as planting material.

AREAS FOR HARVESTING IN 1934.

The composition, by varieties, of the areas in each District to be reaped in 1934 is shown in Table II, while Table III indicates the percentage distribution of each variety throughout the Colony.

TABLE III.

PERCENTAGE DISTRIBUTION OF THE VARIETIES TO BE REAPED IN 1934.

(Varieties listed represent 98.43 % of the Total Area to be Harvested.)

	Total English Acres in the Colony (=100.00%)	Percentage in West Demerara.	Percentage along Demerara River Banks.	Percentage in East Demerara.	Percentage in Berbice.
D. 625:	34,403.7	7.10	9.37	27.82	55.71
Diamond 10:	9,253.1	29.90	62.18	1.74	6.18
S.C. 12 (4):	414.6	36.59	32.50	11.85	19.06
B.H. 10 (12):	897.8	63.28	22.46	8.18	6.08
D. 118:	3,239.4	75.41	24.59	0.00	0.00
P.O.J. 2878:	784.4	21.46	17.95	25.56	35.03
Mixed:	5,227.0	9.98	48.83	15.95	25.24

D. 625, a seedling of the variety Dyer, was bred by Harrison and Jenman in 1892 and recommended in 1901 as "worthy of the attention of the Planters of the Colony for careful experimental cultivation". After 1905 its acreage increased rapidly, but it was not until 1924 that it covered 70 per cent. or more of the cane area. It has held the position of the most important variety in the Colony for many years, and its yields, rather than declining, show a tendency to increase. With the rise in popularity of Diamond 10, however, the area planted to D. 625 seems to be decreasing.

Diamond 10 was bred at Plantation Diamond from a cross between D. 145 and Diamond 185. As might be expected, it has made most progress on lands operated by the owners of Diamond, *i.e.* on the Demerara River Banks and in West Demerara. It is now being rapidly extended elsewhere, however, and the

TABLE II.—VARIETAL COMPOSITION OF THE AREAS TO BE REAPED IN THE VARIOUS DISTRICTS IN 1934.

(Varieties listed represent 98.43% of the total area to be harvested.)

	D. 625.		DIAMOND 10.		S.C. 12 (4).		B.H. 10 (12).		D. 118.		P.O.J. 2878.		MIXED.		TOTAL ENGLISH ACRES TO BE REAPED IN THE DISTRICT.
	English Acres.	Per cent. of Total Area to be Reaped in District.	English Acres.	Per cent. of Total Area to be Reaped in District.	English Acres.	Per cent. of Total Area to be Reaped in District.	English Acres.	Per cent. of Total Area to be Reaped in District.	English Acres.	Per cent. of Total Area to be Reaped in District.	English Acres.	Per cent. of Total Area to be Reaped in District.	English Acres.	Per cent. of Total Area to be Reaped in District.	
West Demerara:	2,444.3	26.57	2,767.0	30.07	151.7	1.65	568.1	6.17	2,442.9	26.5	168.3	1.83	521.8	5.67	9,200.9
Demerara River Banks:	3,224.5	24.84	5,753.8	44.32	134.8	1.04	201.7	1.55	796.5	6.1	140.8	1.08	2,552.1	1.97	12,983.5
East Demerara:	9,567.7	87.74	160.7	1.47	49.1	0.45	73.4	0.67	—	—	200.5	1.84	833.7	7.65	10,904.7
Berbice:	19,167.2	87.15	571.6	2.60	79.0	0.36	54.6	2.48	—	—	274.8	1.25	1,319.4	6.00	21,993.6
Colony:	**34,403.7**	**62.46**	**9,253.1**	**16.80**	**414.6**	**0.75**	**897.8**	**1.63**	**3,239.4**	**5.88**	**784.4**	**1.42**	**5,227.0**	**9.49**	**55,082.7**

area covered by this variety is likely to continue to increase at the expense of that devoted to D. 625.

P.O.J. 2878 is also being rapidly extended, especially in Berbice and East Demerara, but it still represents only a small fraction of the area to be reaped.

The small proportions of B.H. 10 (12) and S.C. 12 (4) grown are mostly concentrated in West Demerara and along the banks of the Demerara river. From the results of field experiments carried out by the Sugar Experiment Station, it seems unlikely that either of these canes will prove as generally suitable as Diamond 10 or P.O.J. 2878.

D. 118 is largely grown in the same districts as the varieties mentioned in the last paragraph. It probably represents, however, a fair proportion of the cane reported from other Districts under the head "Mixed". As mentioned above, continued plantings to this cane cannot be recommended.

Mixed fields represent 9.49 per cent. of the area to be reaped. Along the banks of the Demerara River alone there are some 2,550 acres so classified and in Berbice there are some 1,300 acres. In view of the data presented in Table I, above, it is advisable to use every effort to eliminate such areas without delay.

VERNALIZATION—A RECENT DEVELOPMENT IN AGRICULTURAL RESEARCH AND ITS APPLICATION TO RICE.

BY

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Three bulletins have recently been issued by the Odessa (U.S.S.R.) Plant Breeding Institute which are of considerable interest to agriculturist. In these publications, it is claimed that, by a newly-evolved treatment of the seed before sowing, it is possible to reduce the growth periods of certain crop plants without materially affecting the yield. The practical applications of the process are not difficult to visualise; not only could crops be grown with less risk of loss, but they could be grown where, for climatic reasons, it has not been possible to grow them before.

Professor Lyssenko first applied the treatment to the later maturing, heavy yielding spring wheats, making it possible to grow these types with success in areas where their cultivation was previously precluded by the high summer temperature, which caused serious damage at the time of ear formation.

The treatment has since been applied with success to other crops, such as corn, millet, sudan grass, sorghum, soya beans, etc. The Russian word "Jarowizatzia" (*i.e.*, "springization"[1]) is, however, still applied to the process, while "Jarowisation" is the term used in German publications. The process is described in Bulletin No. 9 of the Imperial Bureau of Plant Genetics, to which the present writer is indebted for the quotations made in this article. In this bulletin, the latinised equivalent, "vernalization," has been adopted, though the terms "Iarovisation" and "Yarvisation" are to be found in American publications.

"Plants may be sub-divided into three types, long-day plants, short-day plants and plants which do not react to differences in day length... Under artificial conditions in the greenhouse it is possible to accelerate or retard reproduction by varying the conditions of light, darkness, humidity, etc., according to the special requirements of each plant." The point made by the Odessa workers is that there are two distinct phases in the vegetative cycle, *viz.*, (1) the growth, or increase in size and weight of the plant, and (2) the development, or the transition of the plant through the successive stages of its life history. These two phases are independent, so if the developmental or reproductive phase is encouraged while the growth phase is kept in check, the plant matures earlier than it would normally, and the fact that this acceleration process can be applied to the embryo before the seed actually starts to sprout makes possible the practical application of the method of vernalization.

[1] J. Hered., 1933: 24: 165-166.

The reproduction phase of tropical and sub-tropical (short-day) crops is accelerated by short periods of illumination alternating with long periods of darkness. Light is necessary for the growth phase and darkness appears to be necessary for the reproductive phase. Lyssenko emphasizes the importance of darkness. He considers that short-day plants do not require an *alternation* of definite periods of light and darkness, but rather a certain total amount of light and a certain total amount of darkness. Thus if, at some early stage of the vegetative cycle, growth were suspended artificially and a concentrated dose of the factors essential for reproduction applied (darkness, temperature, etc.), the reproductive phase would be accelerated in relation to the growth phase. The essence of the process is that these factors may be applied in the early stages of development of the embryo, even before the seed-coat is ruptured, but the seed must first be brought to the requisite condition of suspended growth. The necessary preparation of the seed is somewhat as follows, though the process naturally varies in different cases. Germination is initiated by soaking in water for twenty-four hours, and then further growth is checked by reducing the moisture content or lowering the temperature. This may be achieved by spreading the "seed" in a layer six inches deep and stirring to allow the excess moisture to evaporate. The "seed" is then in a state of suspended animation and should be kept in complete darkness for a length of time and at a temperature which varies according to the species or variety. Sufficient moisture must be added during this period to keep the "seed" alive without allowing too much growth. In the case of maize, the "seed" should be kept for 10-15 days in darkness at 20-30° C. There is as yet no information regarding rice.

Haigh[1] compares vernalization with the customary method of soaking padi and allowing it to germinate under pressure before sowing. In British Guiana, the padi is first allowed to soak for twenty-four hours, then placed in a heap, covered with wet bags or rice straw and allowed to remain thus for two or three days before sowing in the nursery. The presence of sufficient moisture and the rise in temperature within the heap due to the germinating padi produce a more even germination, and tend to encourage growth rather than retard it. Under local conditions, therefore, it is unlikely that any vernalization takes place. In Ceylon, however, the seed is allowed to germinate under pressure for six days, so it is possible that under these circumstances the seed becomes vernalized to a small extent. Experiments are now being conducted at the Georgetown Experiment Station to determine the technique for vernalizing rice seed, the practical application of which is of no small value. For instance, seed padi cannot be sown later than mid-June without grave danger of damage to the crop by the November rains at the time of harvesting. In a season such as the present one, where the delayed rainfall has resulted in extremely late sowing of seed there is every chance that a large portion of the crop will be lost by lodging and fermentation of the grain in the field. In future, if there were insufficient rainfall by the middle of June to sow the seed padi, would it not be possible to put the seed down to vernalize, so that the crop could be sown later and still be taken off the land without loss in yield at the usual time?

[1] Trop. Agriculturist, 1934: 82: 214-219.

THE ESSEQUIBO AUTUMN RICE CROP.

BY

A. de K. FRAMPTON, C.D.A.

Agricultural Superintendent, Essequibo.

AGRICULTURAL CONSIDERATIONS.

There is now on the Essequibo Coast only one sugar estate and rice has become the crop of predominating importance. In the cultivation of rice, water supply is a controlling factor—and in the rice-growing areas of this Colony water supply is almost synonymous with rainfall. Late in 1933 and early in 1934 much crop damage was caused in Essequibo, as elsewhere, from the floods which resulted from the unprecedented rainfall. Owing to the late mid-year rains the planting of the autumn crop was retarded and in many instances curtailed. The following report indicates the situation as it now exists in Essequibo as a result of these unusual circumstances.

As will be seen in Table I, there will be a fairly large reduction in the acreage under padi on the Essequibo Coast with the autumn crop this year. The reduction in the islands is small and not regarded as serious.

The demand for seed padi on the Coast and in Wakenaam was very heavy. The pure line seed from the Experiment Station at Henrietta was insufficient and was kept in reserve for distribution to private seed farms. For general distribution, padi was purchased at Anna Regina where there were large stocks of good quality padi on hand. This heavy demand for seed padi was caused by the losses sustained in the autumn crop 1933 and the spring crop 1934. There was very little padi on hand even for local consumption, and farmers were afraid of sowing what they had stored in case their supplies for food ran short. Rice millers and proprietors had very little padi on hand, and all was needed for milling to fulfil contracts abroad.

TABLE I.

Padi distributed in the Essequibo District, Autumn Crop 1934.

	Pure Line seed from the Experiment Station.	Anna Regina padi and seed farmers.
Essequibo Coast	237 bags	926 bags
Wakenaam and Leguan	193 „	460 „
	Seed Farms Organised.	
Essequibo Coast	37 farms	
Wakenaam and Leguan	29 „	
	Main Seed Plots (Department)	
Essequibo Coast	1 plot	
Wakenaam and Leguan	2 plots	
Total		1816 bags.

From Table II it will be seen that the acreage under padi in the coastal district has decreased by 2,224 acres, or 29 per cent. of the 1932 acreage. The averages in Wakenaam and Leguan have decreased by 184 and 291 acres respectively which is not regarded as serious, as apart from the decrease being small, it is almost entirely due to the season, and lateness of the rains. With the coastal area, however, the position is different. The decrease is very much larger than last year and is not entirely due to the season ; returns show that practically every estate has a reduced acreage this year. There are some exceptions where the acreage increased; this is due to the fact that tenants moved to these estates as more financial assistance for planting was available, *i.e.*, it is a movement of coast farmers and does not indicate an increase from fresh padi farmers. Part of this decrease is due to the season experienced, but it is thought that the greater part of it is due to the fact that farmers are gradually cultivating a smaller acreage and seeking elsewhere for a remunerative living, such as seasonal labour on the sugar estates in other parts of the Colony. Many farmers go away to work on sugar estates when their padi is planted. In consequence of this they do not see the use of cultivating such a large area of padi, as they say they only need to plant sufficient for their home consumption, and to pay expenses such as rents, etc. Prices have decreased year after year since 1929 but farmers continued planting, actually increasing their acreage as they found their profits per acre dropping. 1932 may be regarded as the peak year for padi production in the Essequibo District, practically every irrigated and well drained acre was planted, and a rise in price was anticipated. The price of padi fell still lower, however, and it was after this that the acreage began to decrease.

TABLE II.

Padi acreages—Essequibo District. Comparative Figures, 1932—1934.

District	1932 acres	1933 acres	1934 acres	Decrease over 1932 acres
Essequibo Coast	7,566	6,497	5,342	2,224
Wakenaam	2,800	2,758	2,616	184
Leguan	2,100	2,033	1,809	291

In table comparative padi prices are given ; prices rose in 1934 because of a lack of padi.

TABLE III.

Comparative prices paid for padi.

	1932	1933	1934	
Price per bag	\$ 1.32 & \$ 1.00	\$ 1.00 .84 & .80	\$1.00 \$1.56 & \$1.80	Prices rose, due to lack of padi in the District.

The planting season for the present autumn crop has been particularly trying throughout the District and weather conditions are, to a certain extent, responsible for a reduction in the acreage planted. On practically every estate

it was impossible to get sufficient irrigation water to set nurseries and commence ploughing at the right time, *i.e.*, at the end of April and early May. There were exceptions to this, principally those estates served by the Capoey Conservancy and those estates, Johanna Cecilia to Cullen, served by the controlled swamp savannah. In all the other estates there was a shortage of water and no nurseries could be set until rain fell in the middle of June. The Tapacooma Conservancy estates were worst off in this respect. This conservancy had failed completely due to a breach having occurred in one of the dams. There was no irrigation water available until considerable rain had fallen, and nurseries were set very late in consequence.

TABLE IV.

Rainfall for January—June 1932—1934.

Year	January	February	March	April	May	June
1932	7.35	1.48	4.50	6.32	9.54	11.58
1933	4.62	1.94	2.29	3.61	17.34	7.69
1934	26.62 (to 18/1/34)	1.55	1.63	3.29	3.00	8.50

It will be seen from Table IV that the planting season March, April, May was particularly dry and it is due to lack of rain in these months that planting commenced so late. By forcing cultivation ahead, and planting out at 4—5 weeks instead of 5—7 weeks padi field work will be completed in most areas before August. Table V below shows the different padi planting areas and the normal date for closing cultivation with the closing date this year.

TABLE V.

District	Normal date of closing	Closing date Autumn 1934.
Supenaam to Riverstown	End of June	End of July
Riverstown to Suddie	End of June	1st. week August.
Suddie to Wastelands	End of June	End of July.
Wastelands to Aberdeen	1st week July	End of July
Aberdeen to Hampton Court	2nd week July	2nd. week August.
Hampton Court* to Charity	1st week July	2nd. week August.
River Islands, Wakenaam and Leguan.	2nd week June	End of July.

From the above table the influence of the late rains on the date of planting can be seen. The river islands are very much later in planting this year. In consequence of late planting, the harvest will be later this year and yields are expected to be lower.

*Mostly shied padi and then planted out by "thinning."

General Labour Conditions in Relation to the Padi Crop.

Enquiries have been made throughout the District and the river islands in regard to the padi industry and the labour supply.

In the river islands it has been found that the farmers there are not likely to reduce their cultivation at present. This is particularly so in Leguan. This island is situated near to the West Demerara Coast and has good communication with Georgetown. Farmers there can plant padi, and also obtain employment out of the padi season by coming to the West Coast and working on the sugar estates.

Again, there being several grinding estates on the West Coast, a good sale for garden produce and provisions is found. This, together with the sale of their milk in Georgetown, is keeping the Leguan farmers contented and comparatively independent. In Wakenaam the farmers plant large acreages of padi and provisions. Although padi sells at a low figure their provision farms keep them employed out of the padi season and good sales are obtained for their produce on the West Coast (transport by sailing boat and batteaux is cheap) and Georgetown. Again, they are fairly close to the West Coast and can obtain employment on sugar estates.

On the Essequibo Coast it is a different matter. Farmers are entirely dependent on their padi crop for a livelihood. There is no out-of-season employment, and little sale for other agricultural produce as everyone is self-supplying. Transport of produce to Georgetown is out of the question owing to the distance and cost.

Up to the present time a certain amount of money has been expended each year on relief works; this, although individuals do not earn a lot of money, relieves the position somewhat, out of the crop season. Relief works, however, cannot go on indefinitely and when they are stopped the Essequibo farmer will be faced with the prospect of no employment at all except in his padi field and provision farms. The former no longer pays and the latter need only produce for his home requirements, there being little local sale for surplus. The Essequibo farmer already feels that padi prices will not increase and because of this he is planting a smaller acreage. Conditions generally have tended to dishearten him and he cultivates padi because it is necessary for his existence and not for the profits derived from it, *i.e.*, advances can be obtained from proprietors and credit from shops during crop. When he balances his account, however, he is left with little or nothing, and the same process is repeated with the next crop. In this way with two bad crops running many of the farmers have become heavily indebted (witness the Bush Lot Land Settlement) and it has taken great encouragement, and in many cases, very heavy advances to get the farmers to plant the land. In other words, proprietors in some cases have to advance heavily to get the crop planted, so that they will stand a chance of recovering money outstanding from last year. This factor, together with the prospect of a rise in the price of padi, due to the shortage, has been responsible for getting much of the

land planted; otherwise it is considered that the decrease in acreage would have been larger. Again, were it not for debts owed by farmers which they are trying to pay off this crop, a greater number would have left the coast and gone to sugar estates where more attractive conditions are offered.

It is becoming increasingly apparent that the Essequibo farmer will not be able to remain on the coast and earn his living by padi cultivation. Some form of employment is essential and the only means whereby this could be obtained is through a large sugar estate on the Coast where employment could be obtained, and cane-farming practised. A large sugar estate on the Coast would benefit all classes of the community from farmers to shopkeepers. At present all classes are suffering through the lack of cash in circulation. If there was a large sugar estate on the Coast, all farmers would be employed and the padi lands also cultivated. Moreover, if cane-farming were practised, much abandoned land would be brought under cultivation, and estates would be more beneficially occupied. At present the area beneficially occupied is small and maintenance works are hardly carried out at all.

This question has been discussed with the estate proprietors on the Coast and they agree that if prices for padi remain low, or decline further, they cannot hope to get all their land planted. If this occurs they will be faced with serious losses in capital outlay on their estates and rice mills. Moreover, taxation has to be met on the properties whether cultivated or not.

It will be seen, therefore, that the reduction of acreage under padi in the Essequibo District is serious and that further reduction may be anticipated unless prices rise, or some form of employment is found to keep the people settled on the Coast.

Conclusions.

A reduction of acreage has been recorded in the padi areas of the Essequibo District, due to two causes:—

(1) A late season due to lack of rainfall at cultivation time has been partially responsible.

(2) Poor prices for padi and two bad crops have disheartened farmers, coupled with almost total lack of employment to assist them out of the crop season. These conditions are making farmers seek employment elsewhere in the Colony, particularly on sugar estates, which are offering much more attractive conditions than can be obtained in the Essequibo District.

BEEKEEPING IN DIFFERENT AREAS OF THE COLONY.*

Those of you who were present at the last meeting of this Association will remember how this tour of the beekeeping districts of the Colony came to be undertaken. The Director of Agriculture stated at that meeting that he was anxious to ensure that beekeepers, and especially those in rural areas, should become acquainted with the work being done by the Department and that the inexperienced, should not suffer either from lack of advice or through being unable to visit the Department's Demonstration Apiary. To give effect to these considerations, the Director proposed that an officer of the Department should arrange to tour the beekeeping districts, and of this proposal the Association approved. A tour of the major part of the agricultural area of the Colony has now been made; it is with a view of keeping the Association informed on the general position of beekeeping in the Colony and on what has been accomplished on these visits that this report is being presented this afternoon.

First, it seems desirable to make mention of what the Department has been doing in the directions of advising and collaborating with beekeepers. From enquiries made it appears that beekeeping has attracted attention and given some promise as a potential minor industry in this Colony as far back as the present generation can remember. Despite this, local honey production gave no indication of increasing for many years, and, in 1932, a questionnaire, to the firms selling honey, disclosed that the general view of the selling trade was that good quality honey at a cheap price could best be obtained by importation. The Department of Agriculture, therefore, decided that, apart from general routine activities, a planned effort should be made to discover to what extent the Colony's beekeeping industry might be developed. In 1932, the Department's Demonstration Apiary came into existence and a start was made with ten hives. There were no funds on the Department's votes for beekeeping and the acquisition of bees and equipment was not easy. Nevertheless, a small compound was enclosed, a small bee-house built, an extractor with other essential paraphernalia obtained, and two tested Italian queens ordered. There immediately sprang up a demand by beekeepers for queens bred from imported stock. It was in meeting this demand that the Apiary experienced greatest difficulty. Funds were not available to provide a sufficient number of nucleus hives for mating purposes and the rate of

***A report presented by Mr. H. D. Huggins, Officer-in-Charge of the Department of Agriculture's Demonstration and Queen-breeding Apiary, to the British Guiana Beekeepers' Association at a meeting held on Monday, August 26, 1934.**

supply of mated queens was disappointingly slow. The situation became so serious on account of weak and depleted hives that queen distribution had entirely to be suspended in 1933 and early 1934. The strength of the hives and the number of colonies have been increased and there are at the present time about 50 colonies from which 70 mated Italian queens have been distributed to beekeepers during the last honey flow alone.

Apart from serving to improve the strains of bees in the Colony, the Department's Apiary is useful, particularly to beginners, for demonstration purposes, and the speaker has met few beekeepers, even in the more remote areas of the Colony, who have not found it desirable to visit the Apiary for one cause or another. Further, at the Apiary there is being carried out an experiment with three scaled hives from which it is anticipated that reliable information will be forthcoming in regard to honey flows in the Georgetown area; nucleus colonies containing young laying Italian queens are built up and sold on request at $2.00 each.

It was in order to inform beekeepers throughout the country districts of these services which the Department is now able and willing to provide that this tour was undertaken.

BEEKEEPING IN THE DISTRICTS.

The Georgetown Area.—Georgetown with its precincts was and probably still is the most important honey-producing area in the colony.

At certain periods, when there is an abundant honey flow, the quality of honey collected in Georgetown compares favourably with that obtained in any other part of the country. British Guiana is a sugar-producing country and Georgetown is the port from which most of the sugar is shipped and at which much is continuously stored. There is in consequence an abundant supply of sugar available, apart from the supplies in the numerous groceries and shops. It has been the almost invariable experience of beekeepers that, when nectar is abundant, bees will not resort to stored sugar, but it is during those periods when there is a dearth of nectar that the bees have little compunction about collecting "sugar honey". It is this honey, dark of colour and "sugary" of flavour that has contributed largely to the poor reputation frequently attached locally to local honey. It is for this reason, to no small extent, that the consumption of honey is so small within the Colony and that its use other than for medicinal purposes is not general.

Many of the hive bodies, bottom boards and covers used in the Georgetown area are imported and it is the rule rather than the exception that imported frames are used. The use of worker foundation is general and of full sheets not infrequent. Eight-frame hives are more favoured than ten-frame, although there is a small number of beekeepers who prefer and use the latter, and there is one beekeeper of long standing who retains Jumbo hives in his apiary. Except rarely, queen excluders are used on all hives.

There appears to be a growing tendency for Georgetown beekeepers to operate "out-apiaries" on the outskirts of the city, *e.g.*, Vreed-en-Hoop and the West Bank, the East Bank and lower East Coast. This would appear to be a desirable feature as the honey from these areas is consistently better than that in Georgetown proper.

Essequibo Area.—There appears to be no area more promising for beekeeping in the Colony than Essequibo. A visit was paid to the district late in July. The rainfall precipitation at Onderneeming was 11.85 inches in June and 15.01 inches in July. Despite these heavy rains immediately before, no hive inspected was found to be poorly supplied with stores while many hives examined were ready for extraction.

There are some differences in equipment in Essequibo and in Georgetown. It was pointed out that, in the Georgetown area, many beekeepers use imported hive bodies and that practically all use imported frames. No beekeepers in Essequibo were found using imported bodies and only two using imported frames; in all other cases both hive bodies and frames were of Hoffmann dimensions but home made. Eight-frame hives are almost solely used; some ten-frame hives were under trial but no beekeeper was found who appeared definitely to prefer this type.

In general, foundation is used but only in strips as "starters"; whole sheets are rarely seen. In the absence of whole sheets, there is a comparatively liberal intermingling of drone with worker comb and queen excluders are practically invariable. In the Georgetown area the general practice is to place six or at most, seven frames in the eight-frame honey chamber. The object is to induce the bees to build thicker comb and so provide more wax. This practice is not generally adopted in Essequibo but, in view of the good prices for wax, is worthy of consideration.

In Essequibo a general practice is for hives to be situated with their entrances facing the windward side. This is doubtless one of the factors responsible for the small size of entrance favoured in the district.

Mention may be made of a queen-mating practice in which a small number of beekeepers in Essequibo were found to have faith. Being of opinion that it is possible to induce a queen to mate within the hive, they enclose the entrances of hives containing young unmated queens with strips of queen excluder. The object of this is to make it impossible for the virgin queen to leave the hive and in consequence to eliminate the loss of queens which are on mating flights. The adherents to this practice claim that successful matings have been frequently obtained with the method; the explanation seems to be that prior to becoming enlarged after mating, a queen appears to be able to pass freely through a queen excluder.

Swarming causes much concern to the beekeepers of Essequibo, and this might be anticipated when the conditions are borne in mind—good honey flows, the use of eight-frame hives with excluders, and the presence, not infrequently, of many drones.

Berbice Area.—Beekeeping has not attracted as many followers in this area as one might have anticipated. There is one family of large beekeepers with apiaries in New Amsterdam; there is one beekeeper who has migrated from Georgetown to the Corentyne; and these comprise the sum total of successful beekeepers discovered in Berbice. A beekeeper, apparently a man of intelligence and enterprise, was visited in the Canje district at New Forest. He had purchased an extractor, books, all other essential equipment and had received visits and advice from experienced beekeepers at various times. He had been trying to get an apiary established for the last five years, but was at the time when visited without a single working colony. There is no successful beekeeeper established in the area. Even if the cause of these setbacks is largely attributed to the inexperience of this particular beekeeper, there are other areas in the Colony where the writer has met beekeepers with little knowledge of beekeeping who are succeeding without difficulty.

SUMMARY AND COMMENTS.

The speaker had the opportunity of interviewing and discussing with beekeepers the main topics to which thought is being given by the industry. The more prompt disposal of their honey is apparently the subject uppermost in the minds of most beekeepers at the present time. Although the situation has improved within recent years, it is still unfortunately the case that most of the honey consumed locally is for medicinal purposes. The present system therefore is that beekeepers dispose of their product almost entirely to drug stores who in general make little specification in regard to the type of containers in which the honey is sold; it seems that formerly, little specification was made even in regard to colour and flavour. With the increasing quantity of better grade honey it seems to be to the industry's advantage to ensure that honey is more attractively displayed and yet offered for sale at a moderate price; high retail prices are likely to deter increased consumption.

The average beekeeper at present receives from eight cents to twelve cents per pound for honey wholesale and this price is profitable provided the beekeeper can dispose of his honey readily. The most promising line of endeavour appears to be to increase local consumption. This should be done before the outside markets are sought since foreign prices are considerably lower than those mentioned above.

It would appear therefore that the general desire of beekeepers is that the Beekeepers' Association should endeavour to take the lead in some plan which would ensure the following:—

(1) that good quality honey is always available in groceries as well as drug stores;

(2) that such honey should be in transparent and not dark bottles, but that the containers must be cheap ;

(3) that such honey should be moderately priced enough to encourage its use as a sweet and food ;

(4) that an "Eat More Honey" Campaign be launched locally.

The plan of the Association to supply members with pound bottles at the low price of fifty cents per dozen has been favourably received. In addition, the Association has on order attractive but cheaply printed coloured labels which will further improve the appearance of containers.

With reference to foundation, the experience at the Demonstration Apiary is that. from the facility with which frames can be interchanged between brood and honey chambers, from the control of drones, and from the possibilities of eliminting queen excluders, beekeepers, particularly in the country districts, will find it profitable to use full sheets of foundation more regularly.

Swarming also deserves mention. In those areas particularly where swarming is prevalent, consideration should be given to the use of full sheets of foundation, the disposal of queen excluders, the placing where necessary of more than one honey chamber on strong hives and the presence of young vigorous queens in the hives.

Queen-rearing is one of the most persistent troubles of the local beekeeper mainly on account of insect-eating birds. Beekeepers in different parts of the Colony have stated that September and October appear to be particularly suitable months for queen-rearing because the *qu'est-ce qu'il dit* does not appear to be very active at that season. This is a point which will be checked at the Demonstration Apiary and it will be of some service if other beekeepers would supply the Department with their experience in this connection.

The distribution of mated queens from the Demonstration Apiary is continuing and the following experience deserves mention: Mr. J. B. Goodluck of Mahaicony, East Coast Demerara, received a queen from the Demonstration Apiary in May. The queen was introduced to two frames with brood and a moderate number of young bees. About a week later, two other frames containing brood scantily distributed were further added thus bringing the strength to a four frame nucleus. This hive was inspected on August 18 by the speaker and was then found to consist of three stories all crowded with bees, brood and well stored with honey.

About fifty beekeepers have been visited. It was gratifying to note how cordially these visits were received and the interest with which problems were discussed. It is hoped and believed that mutual benefit will accrue to the Department and to the industry from this interchange of ideas and a recommendation is being submitted that tours similar to this be undertaken periodically.

DISTRICT AGRICULTURAL COMMITTEE MEETINGS.

Meetings of the East Demerara District Agricultural Committee and the West Demerara District Agricultural Committee were held on July 23 and 31 respectively.

The following members of the Committees were present :

DISTRICT AGRICULTURAL COMMITTEE, EAST DEMERARA.

Capt. F. Burnett	...	Acting Director of Agriculture (Chairman)
Mr. M. B. Laing	...	District Commissioner
Mr. E. M. Wallcot		
Mr. W. H. Richards	...	
Mr. S. Andries		
Mr. J. E. Wills		
Mr. Mohamed Ghani		
Mr. E. M. Peterkin	....	Agricultural Superintendent (Secretary)

DISTRICT AGRICULTURAL COMMITTEE, WEST DEMERARA.

Capt. F. Burnett	....	Acting Director of Agriculture (Chairman)
Mr. C. G. A. Thompson		District Commissioner (Acting)
Mr. W. Ramdeholl		
Mr. T. F. Moore		
M. R. P. Carryl		
Mr. J. C. da Silva		
Mr. H. D. Huggins	....	Agricultural Superintendent (Secretary)
Mr. A. A. Abraham	....	Asst. Agricultural Superintendent

Among the important items that arose for discussion were :—

(1) RICE THRESHING MACHINES.

The Chairman outlined the position in regard to rice threshing machines, and pointed out that the Department of Agriculture had conducted trials which indicated that threshing machines were economically justifiable in the local rice industry. To extend the use of these machines, Messrs. Booker Bros. Mc Connell & Co. Ltd., the local agents, had been requested to make demonstrations in the districts in order that rice growers might be convinced of the utility of these machines and eventually effect purchases either on the co-operative basis or on the individual purchase and itinerant renting basis. The agents were of opinion that past experience did not justify the expenditure necessary for further demonstrations of the type outlined. The Bon Accord Company had been written to and were now in communication with their local agents, but it seemed unlikely that the demonstrations asked for would materialise. The Chairman stated that the question should not be shelved as the matter was one of importance to the rice industry.

After discussion it was agreed that Government should be asked to finance the project by purchasing one or more machines for demonstration in the district.

It was disclosed that the cost of a machine such as the one used by the Department was $900 f.o.b. and about $1600 for the larger type. The Chairman pointed out that, apart from the justification of threshing machines on an economic basis, it was clearly indicated, both at the Experiment Station and Hope, that if more of these machines had been available, considerably less padi would have been lost during the heavy rains at the end of the last autumn crop.

There was some discussion as to whether a small, or a large-sized and more expensive, machine should be asked for and it was the consensus of opinion that it would be wiser to demonstrate with a small machine at first; if, after trial, such a machine justified its use in the districts, a more expensive machine should be obtained. It was emphasised that, with the present low prices, the question of cost was an important one.

(2) CASSAVA.

It was reported that the Department of Agriculture had continued to make efforts to obtain price quotations for cassava products. A press note prepared by the Department giving details of prices offered had appeared in the daily papers. The opinion of those present was that the prices quoted could not meet the cost of production in this country and that unless higher prices were offered there was little likelihood of extended cassava cultivation.

The Chairman drew attention to the fact that the prices offered were about 50% higher than those paid in Java and that the problem was therefore one of competing against cheap labour. As a further effort to reduce cost of production, the Director of Agriculture had written to the East with the object of obtaining heaver yielding varities which were reported to be in cultivation in Java and elsewhere.

(3) BANANAS.

The Chairman reported that Mr. N. E. Sanderson and Dr. V. C. Dunlap of the United Fruit Company had visited the Colony on behalf of their principals in order to investigate the possibilities of obtaining banana supplies. The Department had co-operated fully and the Chemist-Ecologist had even been sent to Surinam in order to compare the soils there (on which bananas had been grown and had failed) with soils stated to be suitable for banana cultivation locally. The report was that a striking similarity existed. The Chairman pointed out that from both an economic and a commercial point of view, bananas should be regarded not only as a plant crop, since it was essential for the success of such an industry that high yields should also be obtained in the ratoon crops. In other banana producing countries where the soil was as acid as that examined in British Guiana, the incidence of Panama Disease had always been found to be high. The United Fruit Company had reported that local conditions were so unfavourable that they were unable to reserve banana space on the

Canadian steamships for this Colony. The point of view of the Fruit Company was that if the expenditure of reserving banana space on the boats for British Guiana were incurred, there was every indication that the Colony would be unable to supply 2,000 count bunches per trip, and that was the minimum number necessary to prevent the re-opening of banana storage chambers on the voyage. The possibilities of an export trade with Cavendish bananas were then discussed, but it was indicated that the United Fruit Company were not willing to interest themselves in any variety save Gros Michel.

(4) PLANTAINS.

The Chairman drew attention to a recent editorial, appearing in the *Agricultural Journal of British Guiana* Vol. V, 2, which drew attention to the possibilities of plantain cultivation in this Colony. It was agreed that a sub-committee of the West Demerara District Agricultural Committee be appointed to go into the question of extension of plantain cultivation and to recommend measures calculated to lead to increased production and better marketing facilities of the product. The following sub-committee was appointed :—Messrs. W. Ramdeholl, J. C. da Silva, R. P. Carryl, J. W. Jackson, with Mr. A. A. Abraham, as Secretary.

(5) AGRICULTURAL SHOW.

It was unanimously decided to recommend that the Agricultural Exhibition be postponded to a date not earlier than April 1935 on account of the abnormal weather conditions during the past year.

Reports were made on the position of the District Agricultural competitions. The Chairman expressed the hope that members of the Committees would be willing to evince personal interest in the District Competitions. It was decided that, in future competitions, final judging would be done by members of the Committees.

(6) CANE FARMING.

The Chairman suggested that cane farming was a subject to which the Committees might advisedly give attention, and the question was discussed in some detail. Mr. Moore in reply to an enquiry stated that he regretted there was no land available in the Uitvlugt area for cane farming, but was in general agreement with the proposal made by the Chairman.

(7) FLOOD RELIEF MEASURES.

The abnormal rains of January 6 and 7 following the heavy and continuous rains of November and December culminated in what is known as the 1934 "floods." The Agricultural Superintendents were immediately instructed to inspect and report on the extent of damage done ; as soon as the extent was ascertained, steps were taken immediately to rehabilitate the damaged areas so as to make provision against a shortage of foodstuffs later in the year.

As quick maturing crops were essential, 5 tons of black eye peas were ordered from the U.S.A. and sweet potatoes from Trinidad. The black eye peas

were distributed throughout the Colony, while the potatoes were planted in nurseries in Essequibo and Demerara and cuttings or slips distributed later. Vegetable seed were also ordered from the U.S.A. These were distributed both as seed and seedlings. Sub-station Cecelia on the East Coast was used as a nursery for this purpose.

A total of fourteen thousand dollars was allocated to the Department by Government at various times for flood relief measures. This was expended as under :

Black eye peas and sweet potatoes	$ 1,000
Other planting material	5,000
Establishment of 100 acres pure line padi at Bush Lot for distribution purposes.	4,000
Advances to Pomeroon farmers	4,000

Large quantities of cassava sticks, also eddoes, yams, tannias and corn were obtained from the North West District and distributed throughout East and West Demerara, Essequibo and Berbice, as well as 150 bags of seed padi in Demerara and 300 bags in Berbice.

The various District Commissioners were also granted certain sums of money by the Flood Relief Committee. This was also spent in consultation with the District Agricultural Officers of the Department in purchasing seed padi, planting material and oxen to assist areas short of ploughing oxen in preparing land for the coming rice crop. Government also approved of the removal of duty on gasolene and crude oil for use with tractors for ploughing rice land in the Mahaica, Mahaicony and Abary Creeks on the recommendation of the District Commissioner of East Demerara ; this last measure very considerably assisted the farmers in the more rapid planting up of their areas.

Simultaneously, mixed provision competitions were started in each county, marks being given both for early establishment of food crops and for the size of the area cultivated. Cash prizes were offered. The response to these competitions on the whole was encouraging, and the results obtained by many of the entrants were very satisfactory.

Attention has been paid to the distribution of seed padi in order to ensure as nearly as possible a normal autumn crop. Large quantities of seed have been purchased and distributed free. Much difficulty was experienced in obtaining good quality seed padi.

With the exception of seed obtained from the Department the germination of padi throughout the Colony was poor, due probably to being stored with an excess of moisture, the January floods contributing largely to this.

(8) Interest Charged by Co-operative Credit Banks.

Rates of interest charged by Government on loans to Co-operative Credit Banks were discussed and the general view was that a reduction should be made. It was asked that the question be referred to Government.

PRICES OF NURSERY PLANTS AND CONDITIONS OF SALE.

BOTANIC GARDENS, GEORGETOWN, BRITISH GUIANA.

Prices of plants include the cost of baskets. Flower pots are charged for according to size.

All charges for plants, pots, delivery, etc., must be paid in advance or at the time of purchase.

The prices quoted below only apply to persons resident in the Colony.

Plants can be obtained during the following hours :—7.00 a.m. to 10.30 a.m., and 12 noon to 4.00 p.m. on week days, excepting Saturday afternoons and Public Holidays.

In cases where large orders are placed for plants to be raised, a deposit may be required in advance.

Seedlings of the fruit trees, etc., listed below are usually in stock, but if not available, or where large quantities are required, orders can be booked and the plants raised. The prices are 2 cents per plant, 20 cents per dozen, and $1.50 per hundred.

Bilimbi	*Averrhoa Bilimbi*
Bell Apple	*Passiflora nitida*
Bread Nut	*Artocarpus nucifera*
Carambola	*Averrhoa carambola*
Cocoa	*Theobroma Cacao*
Coffee	*Coffea spp.*
Custard Apple	*Anona reticulata*
Genip	*Melicocca bijuga*
Golden Apple	*Spondias dulcis*
Governor Plum	*Flacourtia Ramontchi*
Granadilla	*Passiflora quadrangularis*
Guava	*Psidium Guajava*
Mammee Apple	*Mammea americana*
Papaw	*Carica papaya*
Pear	*Persea gratissima*
Pimento	*Pimenta officinalis*
Pomegranate	*Punica Granatum*
Sapodilla	*Achras Sapota*
Semitoo	*Passiflora laurifolia*
Sour Sop	*Anona muricata*
Star Apple	*Chrysophyllum Cainito*
Sugar Apple	*Anona squamosa*
Surinam Cherry	*Eugenia uniflora*

Citrus Plants.

Budded grape fruit and orange of standard varieties may be obtained at 30 cents per plant, $3.00 per dozen and $20.00 per 100. Budded oranges from good local seedlings cost 20 cents each, $2.00 per dozen and $15.00 per 100. Special prices may be quoted, however, when large orders are placed.

Budded limes are sold at 15 cents each, $1.50 per dozen or $12.00 per hundred; seedling limes cost 5 cents each, 50 cents per dozen and $4.00 per hundred.

Grafted Mangoes.

There are a number of mango trees of different varieties in the Gardens from which a limited quantity of grafted plants are obtained annually. These are sold at 24 cents each. The varieties available include Julie, Ceylon No. 1, Mrs. Dare, No. 11, Bombay Purple, Colonial Bank, Chinoise, Divine, etc.

Miscellaneous.

Bread Fruit plants are sold at 24 cents each.

Grape Vine plants are sold at 24 cents each.

Eucalyptus seedlings, etc., for shade or windbreaks, are sold at 2 cents each, 20 cents per dozen and $1.50 per hundred.

Ornamental Plants.

A quantity of palms and ferns and a few small flowering plants are kept in stock. Plants required for private gardens, etc., may be ordered and can be supplied in limited quantities. Prices are as follows:—

Palms and Ferns, small	....	....	08 cents per plant.
,, ,, ,, medium	....	....	12 ,, ,, ,,
,, ,, ,, large	....	....	24 ,,—$1.44 according to size.
Anthuriums, Colocasias and other Aroids			24—96 cents according to size.

Trees, Shrubs, Creepers, Begonias, Crotons, etc.,—08 cents to 48 cents according to size.

Roses	....	....	....	24 cents per plant.
Seeds	....	....	....	6 ,, ,, packet.
Cuttings	....	....	....	1 cent each.

Cut flowers, bouquets, wreaths, etc., are under no circumstances sold at the Gardens. The following plants however, for decorative purposes, are for sale when available:—

Pink Lotus Lilies	2 cents each	....	20 cents per dozen.
Nymphaea water lilies	2 cents each	....	20 ,, ,, ,,
Victoria regia lilies	4 cents each		
Bamboo shoots	....	....	12 cents per bundle of 25 pieces.
Bamboo poles	....	....	16 ,, ,, pole.

Plants may be hired for decorative purposes, the charge, exclusive of cartage, being 96 cents per dozen for large plants and 72 cents per dozen for small plants.

REVIEWS.

REPORT ON THE PRESENT CONDITION OF AGRICULTURE IN THE MALTESE ISLANDS.

BY

F. A. STOCKDALE, C.M.G., C.B.E.,
Agricultural Adviser to the Secretary of State for the Colonies.

In making the inevitable re-organisation of agricultural departments' work and policies which modern exacting conditions enforce, it is helpful to view each situation objectively. It is not always easy for one working and living within a colony to do this. For this reason, *inter alia*, the reports which are made by the Secretary of State's Agricultural Adviser from time to time on the agricultural situation in different colonies are of more than local interest.

Mr Stockdale visited the Maltese group of islands from March 23rd to April 8th and his report on the agricultural situation, together with recommendations made, has now appeared. The report is published by the Government Printing Office, Malta; price 7d.

The group of islands consists of Malta and Gozo and two smaller islands. The total area of the group is 111 square miles. There are cultivated in Gozo chiefly winter wheat, barley, the leguminous forage -crop sulla (*Hedysarum coronarium*), summer crops of pumpkins and melons and vines. In Malta are cultivated chiefly wheat, barley, sulla, potatoes, cumin, pumpkins, melons, broad beans, vetches, the ochra pea, onions, cauliflower, cabbage, lettuce, carrot, green peas, spinach, tomatoes, olives, carobs, oranges, mandarins and there is a small production of honey. Agriculture is the chief industry of the islands. The farms are small and average between three and four acres. The smaller farms are operated by the farmer and his family and, except during the time of sowing the spring crop of potatoes, paid help is rarely secured.

In the smaller farms the tillage operations are done by manual labour while on the larger farms mechanical tractors are used either co-operatively or are hired. A description is given of the several cultural implements used on Maltese farms.

The soils consist of true examples of the laterised terra rosa of the Mediterranean area, as well as somewhat heavy clay soils and lighter soils containing a considerable quantity of stones. The lime content of all the soils is high. In Gozo the land is less steep than in Malta.

The rainfall averages twenty inches per annum, half of which falls from November to January and the other half during February, March, April, September and October. During the dry weather, except where irrigation is available there is little or no green produce except the cactus, *Opuntia ficus indica.* Irrigation water is secured from wells by means of Persian Wheels and pumps driven by windmills or oil engines.

The several agricultural and livestock industries, the preparation of products for export, the marketing of produce, agricultural legislation, possible agricultural development, co-operative associations and the local agricultural department are discussed.

The following recommendations are made :—

(1) that immediate steps be taken to effect the re-organisation of the existing methods of marketing;

(2) that the early completion of the Government Experimental and Live Stock Farm be undertaken;

(3) that a vocational agricultural school be established;

(4) that a large scale investigation be made into the immunization of goats against undulant fever;

(5) that trials be made with the conversion of waste material into manure;

(6) that an investigation be made in order to ascertain if the further development of water supplies for irrigation can be economically effected;

(7) that an enquiry be made into the prevailing system of land tenure;

(8) that an Agricultural Produce Ordinance be introduced to assist marketing;

(9) that the Plant Protection legislation be revised;

(10) that the Department of Agriculture be further developed so that greater assistance may be made available for the farming community.

H.D.H.

THE KATAMORPHISM OF IGNEOUS ROCKS UNDER HUMID TROPICAL CONDITIONS.

BY

THE LATE PROFESSOR SIR JOHN BURCHMORE HARRISON,
KT., C.M.G., M.A., F.I.C., F.C.S., F.G.S., F.G.S.A., ETC.

This monograph published by the Imperial Bureau of Soil Science, contains an account of the investigations made by the late Sir John Harrison concerning the nature and origin of the soils of the interior of this Colony and the processes of lateritization.

During 1930 an incomplete and unrevised manuscript was discovered among the records belonging to the British Guiana Department of Science and Agriculture and was shown to Professor F. Hardy of the Imperial College of Tropical Agriculture. Professor Hardy, realising the importance of the subject matter, interested Sir John Russell, Director of the Imperial Bureau of Soil Science, who made arrangements regarding the revision, retyping and publication of the monograph. Donations towards the cost of publication were made by the British Association for the Advancement of Science and by the Demerara Co., Liverpool, Curtis Campbell & Co., H. K. Davson & Co. Ltd., and Booker Bros., McConnell & Co. Ltd., London.

The monograph consists of a technical description of the weathering processes occurring when igneous rocks of different types are exposed to the climatic conditions of the humid tropics. Its scope can best be described by quoting from the preface written by Professor Hardy, to whose lot fell the task of revision.

"It is thus evident that the publication of Sir John Harrison's monograph, "even in its incomplete form, is justified on the grounds of its potential usefulness "as a valuable guide, not only to pedologists but also to geologists and mineralo-"gists whose work may necessitate a full understanding of the profound primary "and secondary changes which rocks may undergo when subjected to the intense "action of natural agents within the humid tropical regions."

The main findings are that basic and intermediate igneous rocks, whether situated at high or low altitudes, become first altered at their surfaces to a thin layer of "primary gibbistic laterite" when exposed to the action of tropical rainfall. At low levels where drainage is restricted and where the water table is high the rise of ground-water during the dry seasons brings about a process of

resilication giving rise to the formation of a reddish kaolinitic lateritic earth often encountered in tropical regions. Further, Harrison showed that acidic igneous rocks in the tropics weather directly to kaolinitic earth without the intermediate formation of gibbisite.

Students of tropical soils are deeply indebted to those responsible for the preparation and publication of this monograph. Friends of the late Sir John Harrison will recognize with pleasure the compliment implied when it is deemed necessary to publish, in these days of financial stringency, a manuscript prepared some fourteen years previously.

Published by the Imperial Bureau of Soil Science, Rothamsted Experiment Station, Harpenden, England ; pp. 80., with a foreword by Sir E. J. Russell and a preface by Professor F. Hardy. Price 5 shillings.

R.R.F.S.

NEWS.

The Department of Agriculture acknowledges with thanks the numerous messages of congratulation which have been sent by readers on the re-appearance of the *Agricultural Journal of British Guiana*, publication of which had been suspended for two years for economic reasons.

Professor the Hon. J. Sydney Dash, Director of Agriculture, returned from vacation leave and assumed duty on September 19. While in Canada, Professor Dash attended, from June 25 to 29, the Annual Convention of the Canadian Society of Technical Agriculturists, at which there were representatives from all parts of Canada and from overseas. Among the important items of discussion was the new legislation in connection with increased Government control of marketing agricultural produce. Papers were also read on different phases of recent economics, soil survey, animal husbandry and horticultural research.

Mr. A. deK. Frampton, Agricultural Superintendent, Essequibo, left the Colony for Trinidad on July 29 on two weeks' casual leave of absence.

Dr. W. A. Archer of the Bureau of Plant Industry, U.S. Department of Agriculture, arrived in the Colony on July 5 to make a study of the poison plants found in British Guiana. Dr. Archer has made the Botanic Laboratory of this Department his headquarters and all co-operation is being given in this work which promises to be of much economic value.

The Head Office of the Department of Agriculture, formerly in Broad Street, was transferred on August 18 to the new office buildings recently erected in Vlissengen Road. The Head Office is now in close proximity to the Botanic Gardens, Chemical Laboratory, Sugar and Rice Experiment Stations, Livestock Farm, and nurseries.

The following agricultural legislation has recently been enacted in British Guiana:

(a) July 13, 1934: Rice (Export Blending and Grading) Regulations, 1934, relating to the blending and grading of rice for export and revoking the 1932 and 1933 regulations.

(b) August 13, 1934: Rice (Export Blending and Grading) Regulations, (No. 2), 1934, postponing the date from August 13 to October 1 on which the Regulations mentioned at (a) should come into force.

(c) October 5, 1934 : Ordinance No. 26 of 1934 to provide for the establishment of an Advisory Board of Agriculture.

(d) October 5, 1934 : Ordinance No. 27 of 1934 to amend the Wild Birds' Protection Ordinance by making provision for the exercise by the Governor-in-Council of the powers hitherto vested in the Board of Agriculture.

The following are the imports of honey into the United Kingdom :—

	1932 cwt.		*1933* cwt.
From the West Indies (chiefly Jamaica)	18,918	...	13,554
From Australia	1,368	...	4,149
From New Zealand	1,845	...	6,710
From Canada	19,648	...	19,000
From Russia	2,156	...	10,325

A recent issue of the *West India Committee Circular* draws attention to the remarkable increase in honey imports from Soviet Russia. This was unexpected in view of the fact that Empire honey enjoys a preference of 7/- per cwt. The Circular also reports that attention was drawn to the desirability of securing an improvement in the condition of honey shipped from the West Indies (chiefly Jamaica) to the United Kingdom. In consequence it is anticipated that there will be a more rigorous enforcement of the Jamaica Agricultural Produce Law which states *inter alia* that "no person shall purchase or offer for sale or attempt to export or export honey which has not been subsided or strained. Such honey shall be free from scum and shall not contain foreign matter of any kind."

On account of increased activity in the British Guiana honey industry the Department of Agriculture is forwarding samples of local honey to the United Kingdom in order to obtain a report of the trade in regard to the quality and the prices likely to be received.

A meeting of the British Guiana Beekeepers' Association was held on Monday, August 27. There were present :—

Mr. W. Minshall—Vice-President (in chair), Capt. F. Burnett—Director of Agriculture (Ag.), Messrs. E. S. Vieira, S. Chaves, J. C. da Silva, K. C. Bose, L. C. Kelly, A. Vieira, F. N. Ince, D. A. Pile, G. A. Houston, S. Wilson, N. A. Rickford, Dr. S. K. Mongul, Masters L. C. McWatt and R. L. Low with Mr. H. D. Huggins, Secretary.

The United States of America have reduced the tariff rate on raw sugar imported from Cuba by 55% in two successive steps within the past three months. This reduction amounts to 66 cents per 100 lbs. and is intended to reciprocate for reduction in Cuban tariffs on a number of products supplied by the U.S.A. It is provided that the existing low rate of duty applies only as long as there are quota limitations on the quantity of Cuban sugar entering the U.S.A. The duty on Cuban rum is reduced from $4.00 to $2.50 per gallon.

PLANT AND SEED IMPORTATION

The following are recent introductions by the Department of Agriculture.

Name	Quantity	Whence Supplied
Economic		
Tonca Bean Seeds	2 lbs.	St. Clair Expt. Stn., Agrl. Department, Trinidad.
"Mamie" Papaw (Salmon coloured variety)	1 packet seeds	Agricultural Office, Belize, British Honduras.
Grapefruit—Budded "Marsh"	500 buds	St. Augustine Nursery, Agrl. Depart., Trinidad.
Black Eye Peas	112 bags	Bureau of Plant Industry, U.S. Depart. of Agriculture, Washington.
Padi—7 Varieties	7 packets	Siam and Java.
Clement Tangelo on 11893 Shaddock	1 plant	U.S. Department of Agriculture, Washington, (through Dr. Wm. Archer).
Seminole Tangelo on 1316—E Stl.	1 plant	do.
Minneola Tangelo on 11893 Shaddock	1 plant	do.
Alltoona Tangelo on 51678—4 (sour orange)	1 plant	do.
Lake Tangelo (seedling)	1 plant	do.
Thornton Tangelo (seedling)	1 plant	do.
Citropsis schweinfurthii (Seedling)	2 plants	do.
Swinglea glutinoso (seedling)	2 plants	do.
Murraya exotica	1 rooted cutting	do.
Paspalum dilatatum	1½ lb. seed	Botanist, School of Agriculture, Cedara, Natal.
Paspalum virgatum	6 ozs. seed	do.
Vegetable seeds (assorted)	45 packets	Messrs. Sutton & Sons, England.
Lime seeds ("B.G.")	200	Dept. of Agrl. Ceylon.
Chilli seed (var. No. 9.)	small packet	New Mexico.
Chico— *Achras zapota Linn.* var. *Ponderosa*	22 seeds	Dept. of Agronomy, Phillippine Islands.
Mango plants— Divine, Peters, Cambodiana, Loriean, Gordon, Cherie	2 plants each	Agrl. Dept., Dominica.
Grapefruit—Budded "Marsh"	100 buds	St. Augustine Nursery, Trinidad.
Orange—Budded		
"Parson Brown"	200 ,,	do.
"Satsuma"	50 ,,	do.
Onion seed	60 lbs.	Messrs. Sinclar, Hamilton & Co. Teneriffe.
Ornamental		
Miscellaneous	157 packets	Messrs. Sutton & Sons, Eng.
Violet Tree— *Phlebotaenia Cowellii*	2 plants	Experiment Station, Puerto Rico.

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the Agricultural and Forest Products of the Colony exported for the first six months during 1934.

The corresponding figures for the same period during the two previous years and the average for the sixteen years prior to that are added for convenience of comparison.

Product		*Average 1916-31*	*1932*	*1933*	*1934*
Sugar	tons	47,914	62,976	65,491	79,396
Rum	proof gallons	681,107	280,860	379,123	420,795
Molasses	gallons	2,106,024	3,021,160	4,859,617	3,553,246
Molascuit	tons	416	nil	77	nil
Rice	tons	8,888	15,278	15,693	9,777
Coconuts	No.	55,691	614,029	355,846	1,031,364
Coconut Oil	gallons	11,085	10,524	7,599	6,425
Copra	cwts.	25,782	6,804	15,451	2,000
Coffee	cwts.	3,874	5,394	6,754	4,012
Lime Juice Concentrated	gallons	3,491	958	nil	2,165
Essential Oil of Limes	gallons	286	541	518	288
Rubber	cwts.	38	nil	nil	nil
Balata	cwts.	2,240	3,288	3,881	1,029
Gums	lbs.	556	1,382	nil	nil
Firewood—Wallaba, etc.	tons	5,226	6,466	7,362	7,802
Charcoal	bags	26,070	32,426	30,388	32,892
Railway sleepers	No.	5,011	3,095	3,035	4,567
Shingles	No.	212,538	639,400	508,250	318,000
Lumber	ft.	83,666	89,847	96,592	53,624
Timber	cu. ft.	102,861	25,008	107,703	99,843
Cattle	head	371	135	76	242
Hides	No.	2,993	1,823	2,872	2,725
Pigs	No.	253	255	82	322
Sheep	No.	6	23	nil	nil

CURRENT PRICES OF COLONIAL PRODUCE.

From The Commercial Review, Journal of the Georgetown Chamber of Commerce, Vol. XVII, No. 11, August, 1934.

SUGAR.

Per 100 lbs. net 3 lbs. per Bag allowed for tare

Dark Crystals for Local Consumption.......................$3.30
Yellow Crystals do. do. $4.00
White Crystals...$4.75
Molasses Sugar...none offering

RUM.

Imperial Gallon. Cask included.

Coloured, in Puncheons—40 to 42 O.P...(for export)...50c.; Hhds. 76c., Barrels 77c.
White, in Hogsheads—10 to 45 O.P...(for local consumption)..............45 to 55c.

MOLASSES.

Per Imperial Gallon. Naked.

Yellow (firsts).. 10c.
Yellow (seconds)..$5\frac{1}{2}$c.
Dark..$2\frac{1}{2}$c.

RICE.

Rice..............per Bag of 180 lbs. gross, Brown Super $4.75 to $5.00. White $4.00 to $4.75 as to quality. Lower Grades $3.50—$3.75 as to quality.
Paddy ....per Bag of 143 lbs gross, $2.00 as to quality.

GENERAL.

Timber, Greenheart, (Lower grade measurements)...40c. to 60c. per c. ft.
for export 72c. to $1.00 per c. ft.
do. Railroad Sleepers—(Mora)...$1.68 each.
Greenheart Lumber.. $60 to $70 per 1,000 feet.
Crabwood Lumber...$60 to $75 per 1,000 feet.
Shingles, Wallaba, 4 x 20 and 5 x 22 inches,.......................... $3.50 to $5.50 per M.
Charcoal, Capped for shipment ....72c. to 85c. per bag.
Firewood...$2.16 to $2.50 per ton.
Coconuts...Selects, $9.00, culls...$6.00 M...Copra $1.25 per 100 lbs.—Prime Copra.
Balata...............................Venezuelan, none. Local Sheet...36 to 38.cts. per lb.
Cocoa...14 to 16 cts. ,, ,,
Coffee..7c. to 8 cts. ,, ,,

N.B,—Duty on Payable value at time of Importation and rate of exchange on day of arrival.

METEOROLOGICAL DATA—APRIL—JUNE, 1934.

Recording Stations & Months.	Rain-fall. Total Inches.	Number of Days of Rain: Under ·10 Inch	·10 to ·50 Inch	·50 to 1·00 Inch	1·00 Inch to 2.00 Inches	Above 2.00 Inches	Total days.	Evaporation Inches	Air Temperature and Humidity: Maximum.	Minimum.	Mean.	Humidity Mean.
Botanic Gardens.												
April ...	2·31	7	2	2	...	...	11	6·01	84·5	76·2	80·3	76·3
May ...	3·31	8	5	1	1	...	15	5·51	85·1	75·9	80·5	78·7
June ...	9·21	7	10	2	4	...	23	4·52	84·6	75·5	80·0	82·2
Totals	14·83	22	17	5	5	...	49	16·04				
Means.	...	...	...	...	...	...	...	...	84·7	75·9	80·3	79·1
Berbice Gardens.												
April ...	2·84	...	1	1	1	...	3	...	85·6	73·5	79·5	75·1
May ...	1·67	...	4	1	...	...	5	...	86·6	74·0	80·3	74·5
June ...	6·23	1	12	1	3	...	17	...	89·8	73·0	81·4	80·8
Totals	10·74	1	17	3	4	...	25	...				
Means.	...	...	...	...	...	...	...	...	87·3	73·5	80·4	76·8
Onderneeming												
April ...	2·21	...	3	2	...	...	5	...	88·8	73·5	81·1	87·6
May ...	7·17	2	6	2	2	1	13	...	89·2	73·4	81·3	85·3
June ...	11·85	...	10	4	5	...	19	...	89·1	73·3	81·2	87·9
Totals	21·23	2	19	8	7	1	37	...				
Means.	...	...	...	...	...	...	...	...	89·0	73·4	81·2	86·9
Hosororo, North West District												
April ...	2·28	4	7	1	...	...	12	...	89·3	*...	...	76·4
May ...	5·94	5	10	2	1	...	18	...	89·6	71·2	80·4	77·8
June ...	10·18	4	11	3	4	...	22	...	88·1	70·8	79·4	83·3
Totals	18·40	13	28	6	5	..	52	...	...	...	...	...
Means.	...	...	...	...	...	...	...	...	89·0	71·0	79·9	79·2

*Defect of Thermometer.

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CONTENTS

(Vol. V, No. 4.)

LIST OF ILLUSTRATIONS.

The
Agricultural Journal of British Guiana.
December, 1934.

EDITORIAL.

PEASANT PROPRIETORSHIP AND CANE FARMING

In a recent issue of the "Times", *Callisthenes* drew attention to the complexity of modern business and was apparently so concerned with the problem that he indicated a direction in which he conceived there might lie some measure of relief. That writer had in mind, especially, the business of the city worker, but the business of the farmer (or agricultural worker, as he may be called) is today also a very complex affair.

The time is not far past when the farmer reared his calf, consumed the milk in his home, later slaughtered the animal in his own yard, used some of the meat himself, sold some to his immediate neighbours, and tanned the skin from which he supplied himself and his family with footwear. That day is apparently gone forever. Butchers' meat and factory shoes have come to stay. To-day the farmer frequently sends his products to, and obtains his supplies from, "the uttermost ends of the earth". The farmer must sell his product for money and with the money obtained purchase those articles for which a new standard of life is continually creating a demand. There is probably no other factor contributing more to the complexity of modern farm life than this involved system of exchange which has necessarily resulted.

Those who obtain their livelihood from the land do not still seek so earnestly after the simple life. There is a growing feeling that luxury and comfort may no longer be restricted to those who live in the town. The picture of the weary ploughman plodding his way homeward is not as accurate as it used to be; as has been said, he now travels on a motor-cycle; he aims after and strives for the amenities of life which those in other occupations enjoy. As a result of this transition, there is much thought being given in our time to the raising of the standard of living of those who work on the farm; agricultural community planning is discussed in newspaper columns cheek by jowl with city planning. There has, as a result, arisen a number of standards by which the progress of agricultural communities is evaluated. One of these standards is the extent of peasant proprietorship.

It is a very widely accepted concept that the progress of civilisation moves towards the family-sized farm.* In England, the feudal system, with the lord of the manor owning extensive areas worked by his serfs, has given place to smaller and independently-operated farms. Farms in Denmark are approximately twice the size of farms in the most progressive parts of the United States; statistics indicate that the average size of farm (in terms of men) in the United States becomes smaller each year. In the tropics, where agricultural development is, by comparison, in its early stages, the large company-owned plantation, worked by hired labour, is still a predominating feature.

In British Guiana, the high cost of empoldering and creating drainage and irrigation facilities continues to be a formidable impediment to the existence of privately-owned successful farms. Apparently only the capitalised company has been able to afford to establish and maintain such facilities. There are names of many a local agricultural site which may bear testimony to the fact that, although the necessary initial capital charges have been borne by a sugar company, individuals later acquiring such properties have not been able to conserve in good order that which they received.

It is apparently not only in British Guiana that these difficulties obtain. In the Silver Jubilee number of the Journal of the Philippine Agricultural College (pp. 459, 460) attention is drawn by the Department of Economics to the fact that, "although strict limitations by law prevent concentration of ownership on a large scale", the trend is *not* in the direction of owner-operated farms. The report further states: "It has been understood that the public land law has very liberal provisions in so far as facilitating farm ownership among the citizens of the Philippine Islands is concerned. But the result of its operation .... has revealed difficulties .... partly responsible for the comparatively small area taken. In studies made .... it was found that one who contemplates taking land has to face many hardships, some of which are entirely beyond his own power to remedy."

In the light of experience there appears to be grown in this country a limited number of crops on the basis of which a prosperous peasant proprietorship is likely to be established. The chief of these crops are: coffee on the pegasse areas, citrus including limes on the high and well drained sites, coconuts on the sand reefs, rice in well irrigated areas.

In reference to coffee, the outlook is promising and some of the most successful farming areas in the Colony are those in which this crop is cultivated. Coffee exports in 1932 and in 1933 were higher than in any year previously.

* *Note*:—We are aware that some do not subscribe entirely to this view. Thus, Sir Daniel Hall, in an address delivered at the thirteenth Annual Convention of the Canadian Society of Technical Agriculturists, July 1933, stated: "At present, the competition between the peasant and the great organisation is still, perhaps, a little doubtful. I do not think the case for the big organised scientific farm has yet been proved to the hilt. Only the other day, I was taken over one of those big organised ranches in Southern California, something like 6,500 acres, chiefly under fruit crops of one kind or another, all managed with the sort of efficiency and organisation that we normally associate with the factory......I cannot but think that in the end the big man with this form of organisation is going to win out."

The plant distributions from the Department's nurseries indicate that interest in citrus production, particularly grapefruit, has been awakened and that young cultivations are being established. On account of the low prices ruling for coconuts and its by-products, there is no indication of extension of this crop. The rice acreage and output have advanced substantially.

It can be seen from the above that the areas to be cultivated in these several crops are definitely restricted—coffee on pegasse soils, citrus on high lands, coconuts on sand reefs. Although the rice areas are potentially extensive, this cereal is cultivated, in general, not by a peasant proprietor class but by a tenant class. It can thus be observed that, for the typical cultivable areas of the coast and river districts, none of the industries above mentioned is likely to give rise to a successful peasant proprietorship—and it is on the coast and on the lower reaches of the rivers that most of the population is settled. In these areas, we know of no industry more likely than cane-farming to lead to material advancement and financial stability of peasant agriculturists who live in the locality of sugar estates.

Elsewhere in this issue, attention is drawn to a meeting of certain sugar producers' representatives and others to discuss a situation that had arisen as a result of the harvesting of immature canes by certain farmers. The recommendations of the meeting indicate the line of action decided upon. That this problem and others will be solved is assured if the method of approach be always, as in this case, one of willingness to co-operate by the farmer, and one of leadership and sympathetic direction by the factory management. This cane farming *contretemps* is attracting attention, as growing pains will whenever expansion and development take place. That the industry is expanding is indicated in the following extract from the 1933 Administration Report of the Director of Agriculture :—

> "The area under farmers' canes in the Colony was returned at 1,525 acres "as compared with 1,331 acres in 1932 and yielded 2,328 tons of sugar "(an increase of 281 tons on the output of 1932 when 2,047 tons were "obtained) indicating that the Department's efforts to foster this industry "are meeting with some success. Assuming that 12 tons of farmer's "canes are required to make 1 ton of sugar and using the price of $2.20 "per ton of cane paid by the estates to the farmers, it follows that the "cane farmers have received from the estates during 1933, a sum of "approximately $61,459."

Cane farming has been increasing, due largely to the sympathetic and broad view taken by the sugar estate proprietors. The Department of Agriculture has adhered to a policy of encouraging the industry and this has been a special

feature of the extension work in those areas where this type of farming is likely economically to be justified. A minimun price for farmers' canes, fixed by the Sugar Producers, has resulted in a higher price to farmers than declining sugar prices now warrant.

These are some of the factors which have been responsible for the extension of cane farming. We attach some importance to the development because we conceive that increased activity in this direction is conducive to a higher standard of progress in those farming communities where conditions permit the pursuit of the industry.

ORIGINAL ARTICLES.

A STUDY OF *MORMIDEA POECILA* DALL.

BY

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Supernumerary Entomologist, British Guiana.

INTRODUCTION.

Rice stands second among the crops of British Guiana, sugar being the first. Its domestic importance can hardly be exaggerated. Together with plantains and cassava it is the bread of the people. Apart from this, there is an export trade worth more than a million dollars per annum.

The Pentatomid *Mormidea poecila* Dall., commonly called the padi bug or Ghandi (a generic term for bugs in Hindi), is a well known pest of padi in British Guiana. It probably does not do as much damage to padi as *Diatraea saccharalis* F. which is always with us, but its outbreaks being more spectacular and destructive, are apt to be more loudly lamented. Its ravages from time to time have drawn fire from entomologists and others resident in the colony, and whilst much valuable information concerning the occurrence of this pest has been gained, practically nothing has hitherto been published dealing with its life-history and bionomics. It is the aim of the following paper to supply this want.

Like many other minor pests in this country, the Padi bug is beset with biological and environmental limitations which keep it in comparative repression most of the time so that several years may elapse without an outbreak. It is not uncommon, however, to have annual recurrences for a number of consecutive years. Attacks are apt to be sudden, acute, and localised, and are perhaps best explained as originating in invasions from over populated grasslands which form the insect's normal habitat. Following these incursions, eggs are laid in great numbers on the rice plants and the following generation which may be exceedingly numerous passes through its entire life-cycle on the rice plant. A second generation is seldom reached on the crop or at all events it is so greatly reduced in numbers as to be negligible. Consequently the outbreak generally subsides and peters out completely in 2 or 3 weeks. In the meantime the toll taken is considerable and in severe cases a total loss of grain often results.

The attack generally occurs when the grain is newly formed and in the milky stage when it is most favoured by the bug, As the kernels ripen and harden the invaders show a strong tendency to move off to younger fields. This peculiarity is of importance as it is a strong argument for co-operation among small farmers in carrying out control measures.

DISTRIBUTION, HISTORY, ALLIED SPECIES AND OTHER FOOD-PLANTS.

Moreira (10) records *M. poecila* as a pest of padi in São Paulo, Brazil, in 1923. There is no record of its occurrence as a pest of padi in any other countries besides Brazil and British Guiana. In British Guiana it has been recorded from all parts of the coastlands and I have observed it as far inland as Arakaka on the Barima river. Cleare (4) mentions an outbreak of this insect in 1923. This is apparently the first record of it in British Guiana. After that it is again mentioned in 1926 (5) in 1928 (6) and in 1930 (7). During the three succeeding years there were no outbreaks. In September—October 1934 a severe but localised attack occurred at Pln. Albion on the Courantyne Coast. It lasted about 3 weeks and many acres of padi were almost completely lost.

It may be of some interest to campare records of allied species in the Neotropic region. Bodkin (1) and (2) records *M. ypsilon* L. attacking padi in British Guiana in 1912 and 1919. Reyne (11) reports a species of *Mormidea* attacking padi in 1919 and (12) *M. ypsilon* on padi and on adjoining fields of *Paspalum virgatum* in Dutch Guiana. Dampf (8) has an account of *M. angustata* Stal. and Essig (9) records *M. prominula* Dall. both on padi in Mexico.

Dampf states that *M. angustata* Stal. appears in the rice in the rainy season and retreats to its native haunts in search of food later on. *M. poecila* Dall. with us appears at the beginning of the rainy season usually but probably dies in the padi fields.

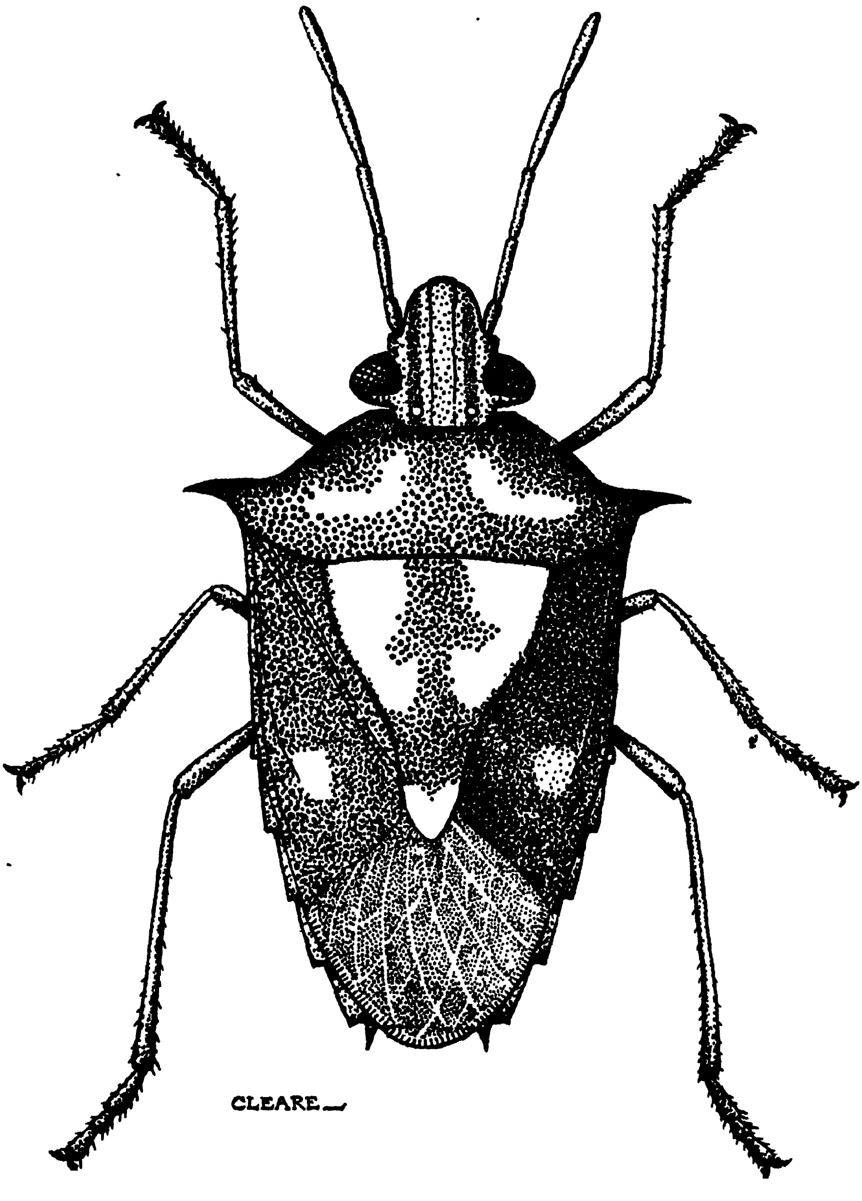
In all these descriptions one fact clearly emerges, the species in every case is indigenous and lives normally on native grasses. The introduction of rice provided them with a new food-plant the adoption of which by the insect we are at present witnessing.

NATURE OF INJURY.

As already stated it is the newly formed milky grain that is most readily attacked. The insect is however capable of feeding on much more advanced grains even in the nymphal stages. The stem and leaves are not attacked. The insect punctures the grain with its proboscis at any convenient point and settles down to a steady meal which it obtains by sucking up what juice the grain contains. When the padi is young and juicy the grains are completely exhausted leaving nothing but empty husks. In a more advanced stage of ripening the damage inflicted is not so great, as grain formation has already taken place and there is comparatively little juice left. Nevertheless even in these cases we find malformation and discolouration of the grain which persist even in the milled rice. These defects are very noticeable and striking and greatly reduce the quality of the final product.

THE ADULT.

Mormidea poecila Dall. is rather a small pentatomid. The males measure from 6.9 to 8.3 mm. with a mean of 7.48 mm., the females from 7.4 — 9·5 with



The Padi Bug, *Mormidea poecila* Dall.
× *10 approx.*

mean 8.78 mm. In each case the estimate was based on 114 individuals taken a random. Fig. 1 shows frequency curves of the length of males and females. Standard error in males ± ·2546 in females ± ·1034 thus shewing a significant difference.

The coloration is as follows :—dorsally dark brown with two faint white tracks on the transverse ridge of the thorax turning forward medially. Two yellow kidney shaped areas in the anterior angles of the scutellum ; a yellow spot at the posterior angle of the scutellum ; and a rectangular white patch on each corium. The membrame wings are smoky blue and iridescent.

The venter exhibits a slight degree of sexual dimorphism. Typical female and male colour patterns are shown in Figs. 6 and 7 respectively. In the former

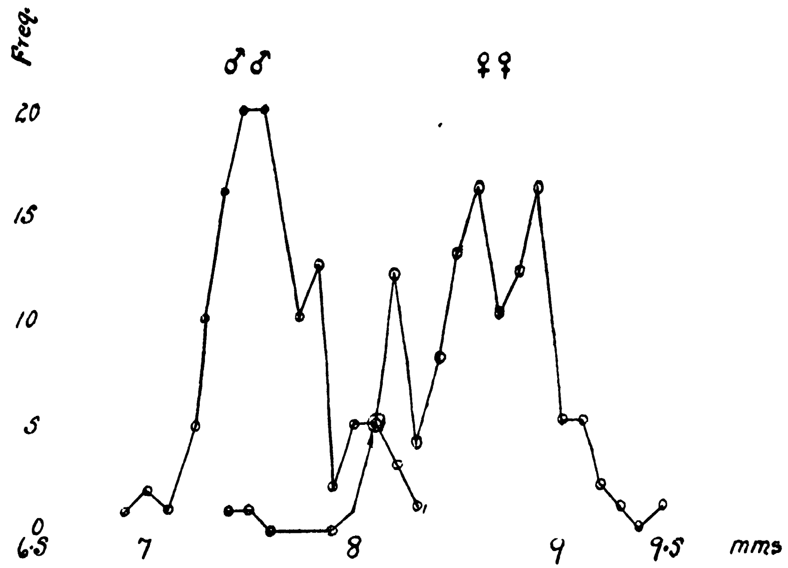


FIG. I.—Length of Males and Females.

the ground colour is invariably white with black markings as shown. The markings vary a good deal in thickness. In the latter there is a yellowish or russet ground colour with markings as shown varying from red to dark brown.

The eggs are cylindrical, slightly rounded at the bottom and measure 0.9 mm. in height and 0.7 mm. in diameter. When first deposited they are bright grass green with a shiny surface. Along the top periphery there is a fine waxy fringe which sticks up and out. Figs. 1a, 1b, 1c and 1d represent the fertilised egg on successive days. After 24 hours the egg turns yellowish and two pink stripes appear across the operculum and extend about 1/3 of the way down on either side where they join up as shewn in 1b. On the third day the top third is cream and the rest pink, whilst the operculm bears two pink and three light brown areas as shewn in 1c. On the 4th day the pink darkens to red and the cream portion is

reduced. On the fifth day hatching takes place. The operculm splits away from the wall all around except at one point where it remains hinged. Unfertilised eggs do not develop the red colour but remain the original green and do not hatch.

THE NYMPHS.

The nymphs on hatching are uniformly flesh-coloured. In the course of an hour or more the body darkens : the head and thorax become light brown, antennae segments 1, 2 and 3 reddish segment 4 brown, legs dark with reddish tint. Abdomen ranging from P. O. red to yellow to green with three black dorsal sclerites and a fringe of 8 pleural sclerites down each edge. The proboscis reaches well down between the third pair of coxae.

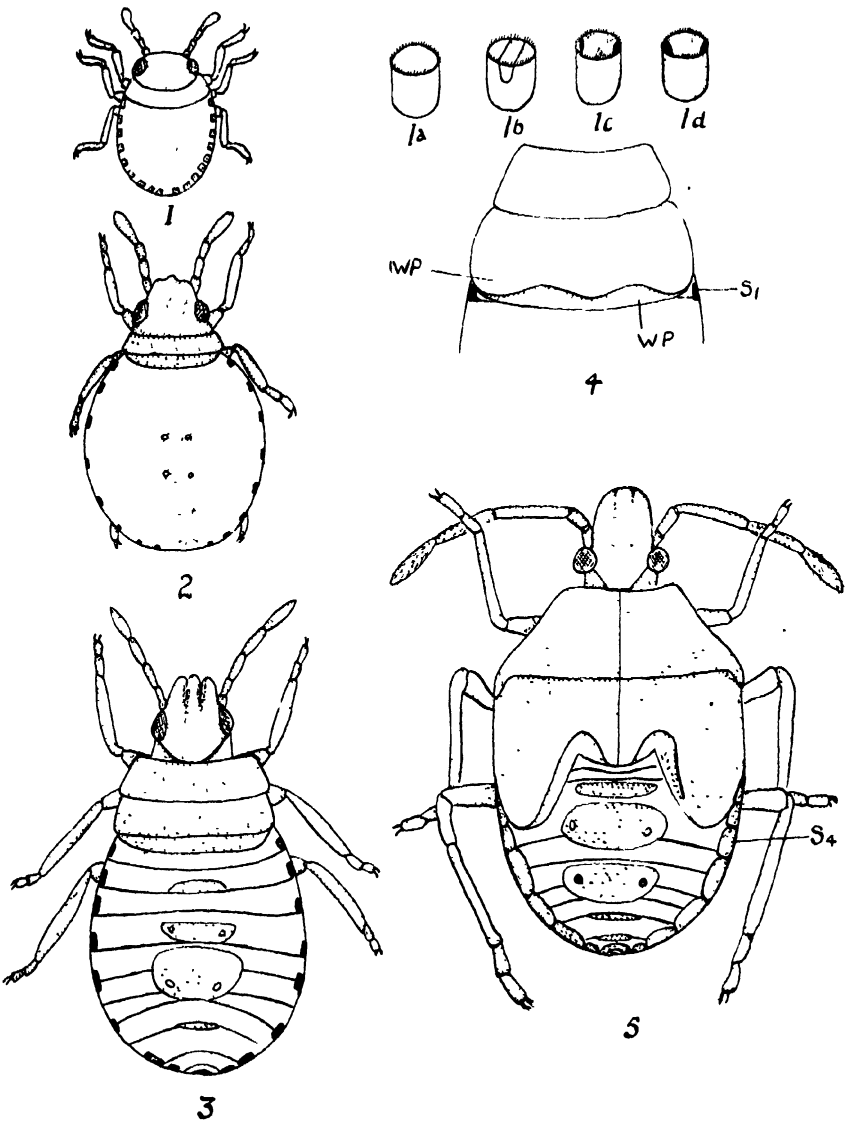
The sclerites, legs, antennae, and head and thorax grow black or grey black towards the end of the first instar and this colour persists throughout the nymphal life. In very rare cases the nymph is entirely green with only a few brownish flecks. The coloration is constant for each type of nymph throughout all its instars. There is no correlation between the differences in the nymphal and the imaginal coloration. Nor are the differences in the nymphal coloration connected with sex. The nymphs are remarkably flat at the commencement of each instar but swell up rapidly until the next moult takes place.

Table I based on measurements of several dozen nymphs of each instar gives some idea of the size of the different stages.

TABLE I.

No. of instars.	Length of nymphs.
1	0.8—0.95 mm. (early) 1.1—1.20 mm. (late)
2	1.2—1.40 mm. (early) 1.4—2.60 mm. (late)
3	2.3—2.80 mm. (early) 3.1—3.30 mm. (late)
4	3.5—3.90 mm. (early) 4.6—5.00 mm. (late)
5	5.5—6.30 mm. (early) 8.0—8.50 mm. (late)

The duration of the instars varies somewhat. Table II based on observations of several lots of nymphs summarises the results obtained.



Egg and nymphal stages.—W.P. = wing pad ; S_1 = 1st Sclerite ; S_4 = 4th Sclerite

TABLE II.

LENGTH OF INSTARS.

No. of Lot.	1st Instar	2nd Instar	3rd Instar	4th Instar	5th Instar	Total min. and max. life cycle.
1	2—3 days	3—4 days	2—3 days	2—3 days	4—6 days	13—19 days
2	2—3 „	2—3 „	3—4 „	3—5 „	3—5 „	13—20 „
3	2 „	2 „	2—3 „	4 „	4—5 „	14—16 „
4	1—2 „	3 „	3—4 „	4 „	4—5 „	15—18 „
5	2—3 „	2—3 „	3—4 „	3—5 „	4—5 „	14—20 „

It will be seen from the foregoing table that the minimum total nymphal period was 13 days and the maxinum 20 days. In the laboratory where conditions were made as natural as possible and with a regular supply of suitable food the majority of the insects reached maturity on the 15th, 16th and 17th days—the frequency trailing off towards the minimum and maximum. The nymphs were reared under the same condition so that the range is apparently a normal one for the species in fairly good conditions.

Moulting takes place in the usual way by splitting down the median dorsum. Before the final moult the nymph hangs itself up head downwards by its hind legs so as to have the benefit of gravity in sliding forth from its old skin. In the case of the younger nymphs no particular attitude was noticed.

The adults on emergence are a cream colour. The process of colouring-up is rapid and perceptible. Within an hour after emergence the full coloration is acquired. This change is apparently independent of light as freshly emerged individuals removed to a dark-room coloured-up in the normal time and manner. Young adults killed by being placed in killing tubes immediately after emergence likewise developed the normal colour-pattern in the usual time.

COURTSHIP, MATING AND OVIPOSITION.

Courtship commences as a rule two or three days after maturity is reached. It is intermittent and promiscuous—the assiduous male passing tentatively from one female to another tickling each with his tarsi and antennae. When a receptive female is found the process becomes more animated and may endure for 5 to 10 minutes but sooner or later mating takes place. Fig. 8 shows the relative position of the external genitalia in copulation. The latter may last for several hours. The maximum time is not known but 8 hours at a stretch was not at all uncommon. The end to end position adopted is fortunately one that entails little inconvenience. The couples are able to move about and feed as usual. Further matings take place on successive days. The male, however, soon dies while the female may continue to lay fertile eggs for several weeks after.

The individual eggs which have already been described are laid in masses consisting of two rows in alternate arrangement so that each egg touches two of the opposite row. The largest single deposition recorded consisted of forty eggs. Sometimes there may be only 4 whilst 12 to 18 is commonest. In captivity these

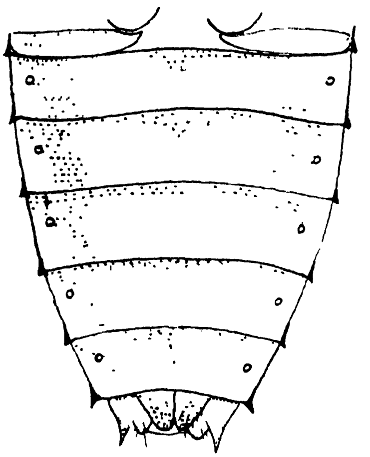
insects seem to prefer to glue their eggs on to rough surfaces. In nature they are generally laid on the leaves or on the grain itself. There is a marked tendency for the females to crowd their egg-masses together so that it is quite usual during fairly severe outbreaks to find as many as six layers of eggs one on top the other. This arrangement does not complicate hatching very much as emergence taking place approximately simultaneously the nymphs beneath are able to push their way through the empty shells; at the same time this device affords the substratae a certain amount of protection from egg parasites. Moreira (10) records as many as 360 eggs to the square inch. This figure I consider a trifle conservative. Oviposition always takes place by night.

Table III show the oviposition of 14 separate females kept each with one male in glass jars and given direct sunlight occasionally.

TABLE III.

Oviposition of *Mormidea poecila* Dall.

Days	Female Number.													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	22	22	20	6	8	4	10	14	10	10	7	4	14	11
2	21	24	17		10	16	12	10	14	13	10	13	17	18
3		25	17	9	23	17	16	8	18	14	17	30	16	9
4		25	11	17	28	11	9	11	13	15	14	22	9	13
5		16	23	11	20	19	19	16	18	16	17	13	12	15
6		21	5	9	21	15	10	24	21	19	11	14	10	19
7		20	11	13	17	21	13	21	17	13	12	15	12	11
8	24	17	17	17	23	15	11	17	11	11		13		5
9	6	11		died	20	15	15	10	died		14	13	died	
10	17	9	15	on	21		14		on		12	14	on	died
11	27			8th	20	15	20		9th		23	26	14th	on
12	23	15	4	day	11	8	13		day	3	23	8	day	8th
13	21	17	6		21	5	14	21		3	died	19		day
14	7	18	7		15	21	11	15		14	on			
15	died	15			14	14	9	9		21	13th	died		
16	on	17	died		15	died		11		22	day	on		
17	14th	14	on		15	on		9		24		14th		
18	day	14	14th		12	15th	died	15		13		day		
19		5	day		11	day	on	11		21				
20		10			15		15th	11		9				
21		14			16		day	8						
22		12			4			11		died				
23		11			died			5		on				
24		15			on			died		20th				
25		18			22nd			on		day				
26		9			day			23rd						
		died						day						
		on												
		27th												
		day												
Totals	168	394	153	82	360	196	196	257	122	241	160	204	90	101



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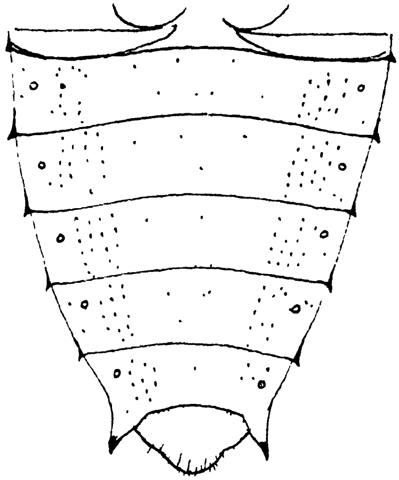

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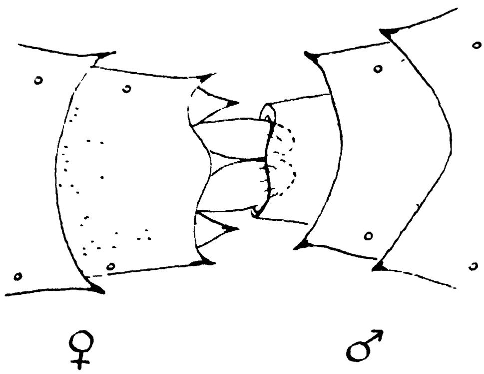

♀ ♂

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Nos. 6 and 7.—Abdominal patterns of female and male. No. 8.—Position of external genitalia in copulation.

It will be seen that the record is 394 set up by No. 2. No. 4 came last with 84. The average number of eggs per female is 194.6. The eggs it will be seen were laid in small masses from day to day, one mass per day per female. In a few cases there was a break of a day or more as in the case of No. 1 for 5 days. The egg-laying extended over a period of from 7 days in the case of No. 13 to 26 days in the case of No. 2. With the exception of No. 13 which ran on for 8 days after cessation of oviposition, egg-laying went on till death took place.

HABITS.

In captivity all stages when not feeding tend to take shelter between or underneath objects. When disturbed they may take to the wing. Their flight is of moderate speed, and they seldom fly more than a few feet at a time. Their most characteristic movement is side stepping round to the other side of objects instead of merely running away when an attempt is made to catch them with one's fingers. They are very agile at this and at times this way of escaping capture becomes quite uncanny. Sometimes they simply drop off as if dead, and fall to the ground.

Another striking feature of this insect is its buggy odour. This vaguely reminds one of the smell of prussic acid but is really much more unpleasant when the two are closely compared. It is due to a clear volatile yellowish fluid. In the 5th instar nymph this liquid issues from two symmetrically situated pores in the 2nd and 3rd dorsal sclerites. In the adult there is an osteolar canal on each side arising between the 2nd and 3rd coxae running outwards and opening in a long osteole facing backwards. There is a dark convoluted triangular plate at the osteole. This is the so-called evaporating surface and in other bugs it has been credited with ensuring the total volatilisation of the fluid on the body of the insect. In the case of the padi bug this function is exactly reversed. The plate is waxy and is not wet by the repugnatorial fluid and when the insect is in its natural position the drops would be ejected from the osteole on to the plate and fall away from the insect. Some of the fluid does, however, evaporate on the body of the bug in the following manner: the osteolar canals communicate with the sockets of the 2nd and 3rd coxae and with the glands. Sometimes the fluid appears in these sockets and overflows into the surrounding sutures and thus spreads all over the thorax and part of the abdomen. The insect appears capable of emitting the fluid in either of these two ways to suit the circumstances.

NATURAL ENEMIES.

The only natural enemy of this pest so far observed is a small chalcid egg-parasite. It is black with the legs and scapes of the antennae light brown. Length 1 mm. It undoubtedly is a check on the pest and egg-masses collected from the rice fields during outbreaks shew a high incidence of parasitism of the surface eggs. There is one parasite to each parasitised egg and emergence takes place through a hole in the operculum which does not come away from the walls as in the normal hatching. The parasite has other hosts notably a cecidomyid which forms the well-known conical galls on cassava leaves. As many as ten of these chalcids may emerge from a single gall. This chalcid has not yet been de-

termined. No other natural enemies of this insect have been observed. Birds have not been seen feeding on them, and are probably put off by the buggy odour.

CONTROL MEASURES.

The only practicable control measures are the destruction of the larger and more conspicuous egg masses and the collection of the insects with hand nets. The areas involved however are usually considerable and it requires close co-operation between the farmers to carry out these measures effectively and expeditiously. A campaign should be organised when the outbreak is first reported and all the farmers in any particular locality should concentrate their efforts on the fields that are being attacked. As previously stated the migratory habits of the pest and the danger that consequently threatens each man should be a sufficient incentive for the farmers to combine and pool their labour for a few days to make an onslaught on the common enemy.

Hand sweeping has been recommended before (6) but there is no evidence that it has ever been seriously attempted on a large scale as a means of controlling the padi bug.

FURTHER INVESTIGATIONS.

As already stated the nymphs exhibit an interesting variation in colour: firstly there are the rather rare forms that are entirely green with a few brown flecks. The rest all have head, thorax, legs and sclerites black or dark. In these cases the ground colour of the abdomen varies from P.O. red to yellow to green. The work of selecting types and breeding them with the object in view of obtaining pure strains was begun in collaboration with Mr. L. E. Codd, the plant breeder to this Department. It is hoped to publish the results of this investigation shortly.

ACKNOWLEDGMENT.

Plate I. is taken from "The Padi Bug" by L. D. Cleare, (see ref. 6.)

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SOME PRICE AND OTHER RELATIONSHIPS OF FERTILIZERS IN BRITISH GUIANA.

BY

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INTRODUCTION.

Practically all of the fertilizers used in British Guiana are employed in the production of sugar cane. The production of cane sugar is the most important industry of the Colony. The average value for the last 24 years of sugar and its by-products exported represents 69 per cent. of the total value of the Colony's exports and it has been calculated that 50 per cent. of the population is directly dependent on the sugar industry. Although fertilizer may not be considered one of the major imports into the Colony and is not a major charge in the production of sugar, yet the fertilizer question has within recent years attracted much consideration. Sugar yields of the Colony have advanced but prices have fallen more rapidly. While, therefore, there has been on the one hand the willingness of the planter to exploit to the full the use of sufficient manures to help maintain increasing yields, there has been, on the other, the desire to reduce the cost of production on account of falling sugar prices. It seemed feasible that there might exist some association between fertilizer use, fertilizer prices and sugar prices and that fertilizer policy (as indicated by import figures) might to some extent be influenced by these relationships. It was to discover the extent and possible significance, if any, of these relationships that this study was undertaken.

All the fertilizer used is imported, even suitable lime or limestone being economically unobtainable locally. The present practice is to import fertilizer salts unmixed, and they are most usually applied singly. Importation is entirely in the hands of the firms or town-agents who control sugar estates and who usually import only their individual requirements, sending the fertilizer out to the estates as soon as possible. One firm keeps a small stock on hand from which occasional local purchasers can be supplied.

So far as is now known, only a comparatively small portion of the cane area will respond to phosphatic applications, and a still smaller area appears to need potash, therefore nitrogenous fertilizers (for the past several years, almost

exclusively sulphate of ammonia) are most in demand and planters are loth to instal mixing machinery for the comparatively small areas where mixed fertilizers are needed. Fertilizers are distributed in the planting rows by hand at a cost of about 15 cents per acre for a 2 cwt. application, and it is not unusual to make as many applications as there are salts to apply, and even to split a 2 or 4 cwt. dose of sulphate of ammonia into two applications.

As stated above, manures are applied in the row, lime and phosphates being given as soon as possible after planting, and nitrogen six weeks later. Except near the open drains where it is feared that the fertilizer may be washed away by the surface run-off, it is not now usual to cover or bury fertilizers at the time of application, although, of course, the cane rows are 'moulded up' some time after.

It is customary to give about 2 cwt. of sulphate of ammonia to plant canes on flood-fallowed frontland clays* and silts and about 3 cwt. per acre to ratoons; both plants and ratoons on pegassy areas* are given about 3 cwt. of sulphate of ammonia per acre. Recent field trials indicate that heavier applications of sulphate of ammonia may be advantageous on ratoons on frontland soils and on both plants and ratoons on pegasse areas. If these results are confirmed by experiments now established there may be a considerable rise in the imports of sulphate of ammonia.

Next to sulphate of ammonia, the most important amendment imported is lime. Under this general term can be included, for convenience, pulverized limestone which has been imported in increasing quantities in the past two or three years. Lime is applied by hand and in the row to plant canes only. Its use is common but not universal. It is given at the rate of 10 cwt. to one ton per acre.

Superphosphate of lime is applied at the rate of about 3 cwt. per acre to plant canes or at a lower rate if applications are also to be made to ratoons. Basic slag, the other source of phosphate in common use, is usually applied only to plants, and at the rate of 5 to 6 cwt. per acre.

Very little sulphate of potash is imported at present. One concern used it in 1933 at the rate of 0.36 cwt. per acre.

Topographical conditions render the keeping of large herds of transport and ploughing animals unnecessary. The same conditions render the preparation and application of farmyard manure costly. In consequence, farmyard manure is hardly used in British Guiana cane fields. Filter press refuse from the factory is sent out to the fields and spread along their outer portions. A few spasmodic efforts have been made to use molasses as a manure, but it is not yet so employed generally. What is true of molasses is true of green manures and cover crops.

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* *Note*: There are two main soil types on which canes are grown in British Guiana :—

(1) Frontland clays and silts consisting of heavy-texured, markedly acidic topsoils overlying neutral or alkaline clay subsoils charged with soluble salts of sodium and magnesium ;

(2) Pegasse soil with highly acidic topsoils possessing considerable amounts of organic matter of wide carbon : nitrogen ratio, overlying highly acidic bleached clay subsoils.

In the present article comparative statistics of fertilizer imports and prices and sugar exports and prices for the period 1910 to 1933 are presented, and such deductions made from them as will be likely to be of interest or value.

STATISTICS OF THE LOCAL TRADE.

AREA DEVOTED TO CANE.

During the period the annual area under cane has varied from 57,200 to 78,300 acres with a mean of 65,400. From 1910 to 1913 the area kept fairly steady at 68,000 to 70,000 acres, but from 1914 to 1919 it was always over 70,000. Then there was a decline, and from 1923 to 1930 the area never exceeded 60,000 acres. There are signs of a slight upward trend since 1930. The detailed figures for the period are presented in Table I.

TABLE I.—British Guiana Sugar Exports and Fertilizer Imports for the Period 1910—1933.

Year.	Area in Cane, English Acres.	Sugar Exported.			Fertilizers (all kinds) Imported.			Fertilizers (excluding Lime and Limestone) Imported.			Lime & Limestone Imported.		
		Tons.	Value, $.	Value per Ton, $.	Tons.	Value, $.	Value per Ton, $.	Tons.	Value, $.	Value per Ton, $.	Tons.	Value, $.	Value per Ton, $.
1910	69,737	100,995	4,994,231	49.47	15,348	700,315	45.63						
1911	68,703	98,453	6,165,469	62.62	12,827	629,953	49.11						
1912	68,389	77,821	4,893,545	62.83	11,625	564,885	48.59						
1913	69,235	87,414	5,292,816	60.55	14,949	631,746	42.26	14,122	626,934	44.39	827	4,812	5.82
1914	73,108	107,138	7,559,152	70.55	12,780	590,402	46.20	11,223	581,285	51.79	1,557	9,117	5.86
1915	75,744	116,224	9,882,972	85.03	16,543	775,187	46.86	13,938	748,280	53.69	2,605	26,907	10.33
1916	78,346	101,650	10,082,005	99.18	17,747	971,703	54.75	15,076	942,152	62.49	2,671	29,551	11.06
1917	77,828	114,407	12,000,140	105.26	13,089	1,129,080	86.26	10,668	1,100,031	103.12	2,421	29,049	12.00
1918	73,565	93,901	9,920,564	105.65	10,864	1,095,993	100.88	8,172	1,049,607	128.44	2,692	46,386	17.23
1919	70,876	83,139	11,883,169	142.93	11,246	976,712	86.85	11,044	973,374	88.14	202	13,338	16.52
1920	69,532	83,765	20,126,316	240.27	19,030	2,176,214	114.36	17,118	2,133,139	124.61	1,912	43,075	22.53
1921	63,420	108,270	10,099,891	93.28	9,384	888,467	94.68	8,392	867,313	103.35	992	21,154	21.33
1922	60,761	90,570	7,175,169	79.22	9,632	540,790	56.14	8,430	524,254	62.19	1,202	16,536	13.75
1923	57,814	83,166	10 257,450	123.09	11,909	733,736	61.61	10,206	711,315	69.70	1,703	22,421	13.16
1924	57,190	85,896	8,482,200	98.75	13,895	647,734	46.62	11,664	619,726	53.13	2,231	28,008	12.56
1925	57,500	97,714	6,785,740	69.43	13,138	583,688	44.43	10,001	548,241	54.82	3,137	35,447	11.30
1926	58,589	84,659	6,050,257	71.46	11,569	478,459	41.36	8,763	445,507	50.84	2,806	32,952	11.74
1927	59,271	109,616	8,787,585	80.17	14,649	528,687	36.09	11,142	487,910	43.79	3,507	40,777	11 63
1928	57,625	114,687	8,124,666	70.86	12,764	447,955	35.10	8,998	406,665	45.19	3,766	41,290	10.96
1929	57,247	109,419	5,943,788	59.17	12,224	455,471	37.26	9,664	429,420	44.44	2,560	26,051	10.18
1930	57,244	114,542	5,418,884	47.31	12,585	405,621	32.23	9,831	378,227	38.47	2,754	27,394	9.95
1931	61,097	119,346	5,325,755	44.62	13,630	365,551	26.82	10,391	332,567	32.01	3,239	32,984	10.18
1932	62,905	137,078	6,442,515	47.00	15,279	351,078	22.98	10,913	309,007	28.32	4,366	42,071	9.64
1933	63,093	127,083	5,745,151	45.21	15,367	382,642	24.90	10,618	340,073	32.03	4,749	42,569	8.96

SUGAR EXPORTS.

Table I also shows that only in part has the quantity of sugar exported had the same fluctuations as the area devoted to cane. This is explained by the varying effects of the weather and by the fairly constant rise in the output per acre. Thus, for the years 1910 to 1913, the average annual area was 69,016 acres, and the average annual exports 91,171 tons. For the four years ending

TABLE II.

British Guiana Sugar Cane Acreage and Sugar Exports.

	1910-13	1930-33	1930-33 Figures expressed as percentages of corresponding 1910-13 figures.
Average acres in cane	69,016	61,085	88·5%
„ tons sugar exported	91,171	124,512	136·6%

1933 the average annual area was only 61,085 acres, but the average annual exports were 124,512 tons. Therefore although the acreage in cane has been appreciably reduced the increase in yield per acre has been enough to advance the exports of sugar materially. This is shown clearly in the last column of Table II where the 1930-33 figures are expressed as percentages of the 1910-13 figures.

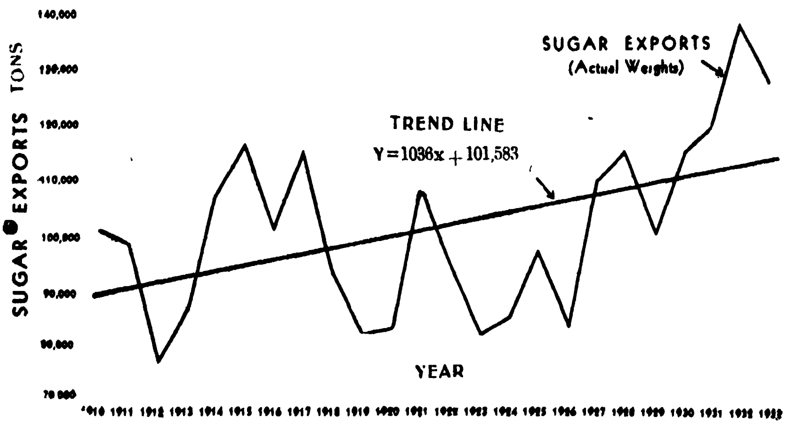

FIG. I. British Guiana sugar exports (in tons) and trend line, 1910—1933.

Figure I shows the annual exports of sugar 1910-33. The trend has been found to be an increase of one per cent. per annum and the trend line is shown on the graph.

Sugar Values.

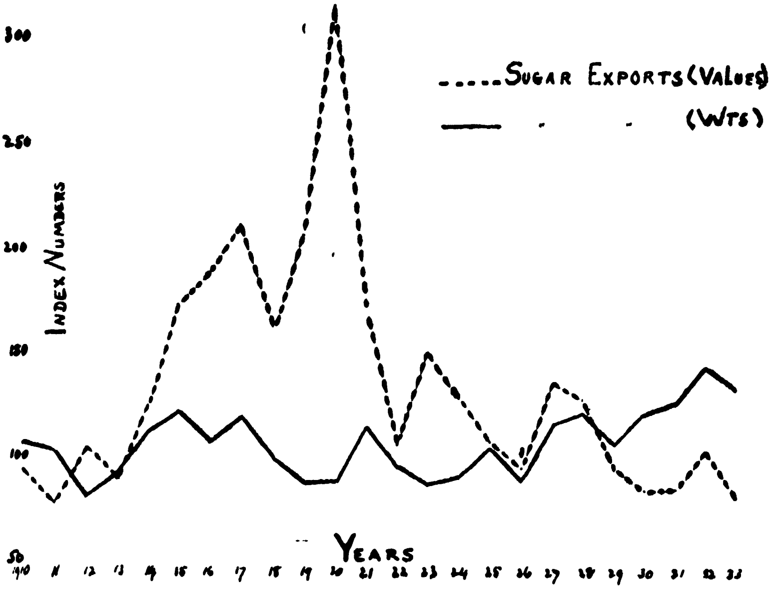

Fig. II. Quantity and value of British Guiana sugar exports (1910–14=100)

Sugar values and sugar exports are compared in Figure II. It is clear, from a further consideration of Table I, that neither acreage, nor quantities exported have shown such violent fluctuations as have sugar values, whether considered as value per ton or as total value of exports. The former has varied during the period by as much as 540 per cent., the latter by as much as 410 per cent. It is interesting to note that the average annual value of the sugar exported in 1930-1933 ($5,733,076) was only slightly in excess (107.4%) of the average annual value of the 1910-1913 exports ($5,336,515), whereas the quantities exported (Table II) were 36.6 per cent. higher. The explanation is that the price per ton of sugar in recent years has averaged well below the price received in the years immediately prior to the Great War.

Fertilizer Imports.

Table I also shows the total imports of fertilizers. These have varied from 9,400 to 19,000 tons, with a mean of 13,400. Importations were relatively heavy in 1910, 1915, 1916 and 1920, and low in 1912, 1918, 1919, 1921, 1922, 1923 and 1926. The past few years show a new upward movement, but over the whole period, there has been a slight downward trend—a decreasing rate in number of tons imported of one and a half per cent. per annum (see Figure III).

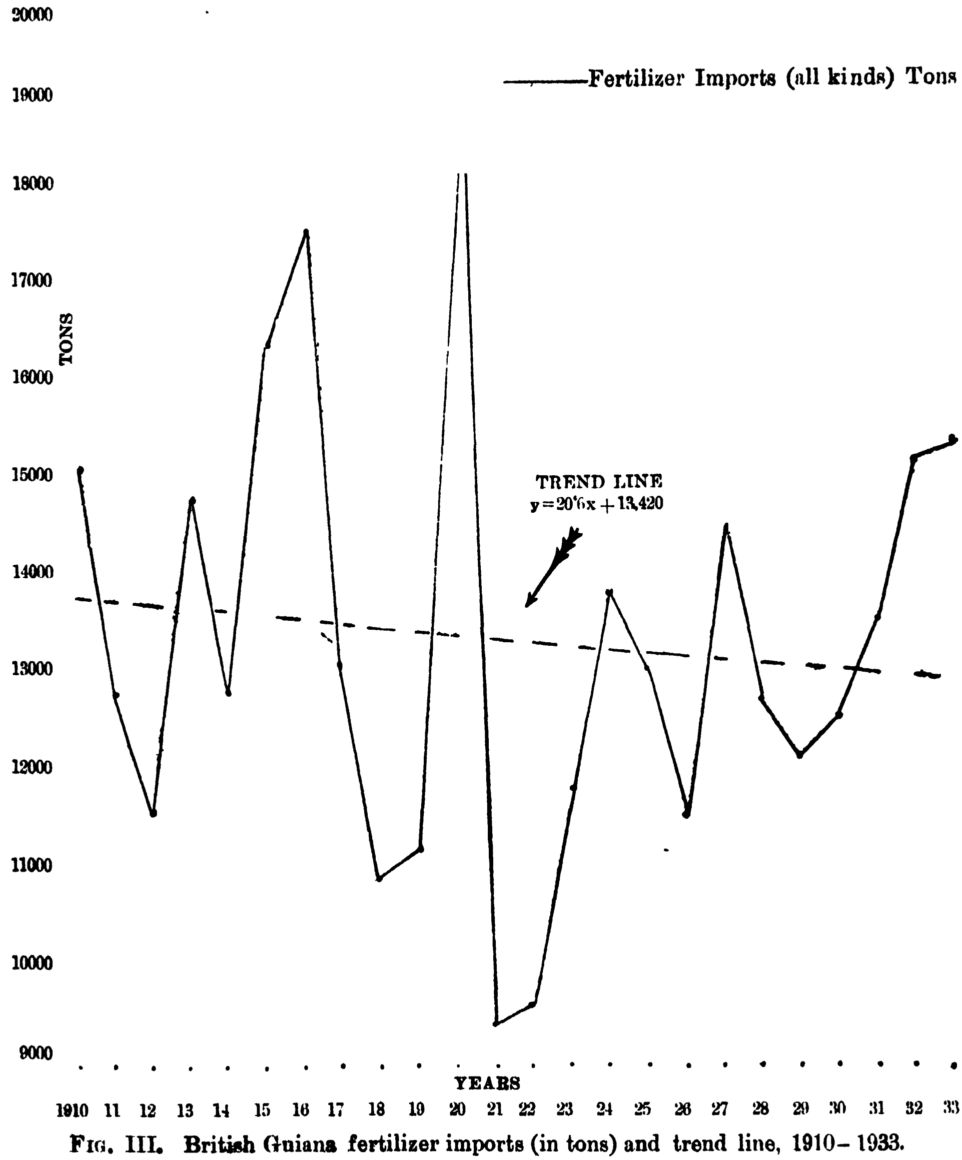

FIG. III. British Guiana fertilizer imports (in tons) and trend line, 1910–1933.

When the respective trends are eliminated there is a positive and significant correlation between cane area and total fertilizer imports. On the other hand, calculation of the appropriate correlation coefficients shows that neither fluctuations in price of sugar nor fluctuations in fertilizer prices have had any effect on the quantity of fertilizer imported. Fertilizer costs and imports are shown in Figure IV.

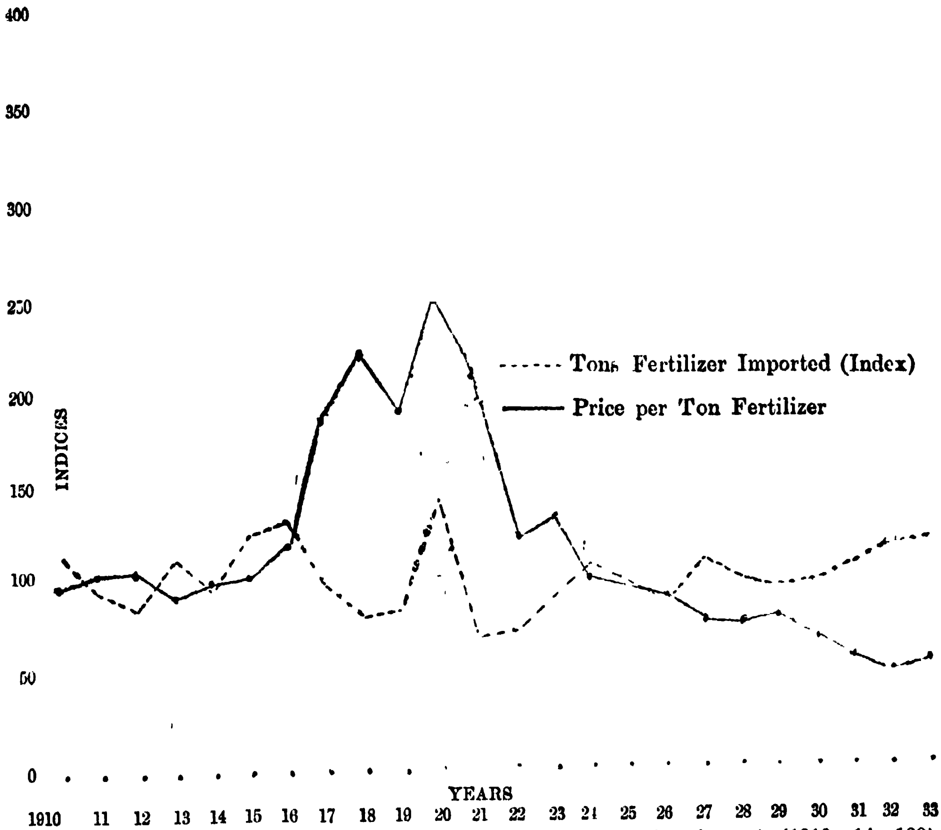

FIG. IV. Quantity and price per ton of British Guiana fertilizer imports (1910–14=100)

It seems therefore that, in general, the major factor influencing total fertilizer imports is the area in cultivation. This is easily understood. The planter realizes that even if no other fertilizer is used, sulphate of ammonia is essential, and that, under local conditions, it is impracticable to grow cane without a certain amount. On the other hand, there is a fixed upper limit, under any given ecological and market conditions, of the amount of fertilizer that cane can profitably utilize and it is uneconomic to make applications beyond this point even if fertilizer prices be low. Further, fertilizers are not a major charge against the cost of producing sugar in British Guiana. At the present time, for example, the sulphate of ammonia usually given to an acre of plant cane costs about \$4.00. An acre is given three or four weedings at \$3.00 to \$5.00 per weeding and two forkings at about \$5.00 per forking, in addition to the cost of preparation, planting, irrigation, drainage, etc. Nevertheless, if the fertilizer policy changed, and the money devoted to lime was spent in some less bulky product, or *vice versa*, then the tonnage figures for importations would show a marked change.

The sugar soils of the Colony are becoming increasingly acid and the data for lime and limestone given in Table I indicate that there has been a tendency to import more and more of these products (burnt lime has predominated but in the past three years pulverized limestone has also been used), there being a very definite upward trend from 1921 onwards. The quantity of lime-bearing materials imported in 1931-33 was two and a half times that imported in 1913-15, albeit this tendency may receive a set-back from the results of recent experimental work with lime and limestone executed by the Department of Agriculture, since the indications are that little or no immediate benefit is to be derived from the application of these even to very acid. frontland clays and silts.

It has not been possible to obtain separate data for each type of fertilizer imported during the period under review, but through the courtesy of the Customs Department, which supplied the figures, some idea of the general composition of the imports can be gained from Table III. It will be seen

TABLE III.—Fertilizers Imported in Recent Years in British Guiana.

Year.	Nitrogenous Fertilizers (almost entirely Sulphate of Ammonia).			Manurial Lime (including Limestone).			Other Fertilizers (mainly Superphosphate and Basic Slag together with some Sulphate of Potash).			Total Imports.	
	Tons.	Value, $.	Value per Ton, $.	Tons.	Value, $.	Value per Ton, $.	Tons.	Value, $.	Value per Ton, $.	Tons.	Value, $.
1926	6,691	403,407	60.29	2,806	32,952	11.74	2,072	42,100	20.32	11,569	478,459
1927	7,271	393,084	54.06	3,507	40,777	11.63	3,871	94,826	24.50	14,649	528,687
1928	6,721	359,526	53.49	3,766	41,290	10.96	2,277	47,139	20.70	12,764	447,955
1929	6,693	358,231	53.52	2,560	26,051	10.18	2,971	71,189	23.96	12,224	455,471
1930	7,207	316,158	43.87	2,754	27,394	9.95	2,624	62,069	23.65	12,585	405,621
1931	7,165	249,107	34.77	3,239	32,984	10.18	3,226	83,460	25.87	13,630	365,551
1932	8,294	254,726	30.71	4,366	42,071	9.64	2.619	54,281	20.73	15,279	351 078
1933	7,681	263,456	34.30	4,749	42,569	8.96	2.937	76,617	26.09	15,367	382,642
Mean:	7,215	324,712	45.00	3,468	35,761	10.31	2.825	66,460	23.53	13,508	426,933
% of Annual Imports:	53.41	76.06		25.68	8.37		20.91	15.57			

that nitrogenous fertilizers represent 53 per cent. of the tonnage and 76 per cent. of the value imported during the past eight years. The corresponding figures for lime-bearing materials are 26 and 8 per cent., respectively, while 'other manures' (mainly phosphatic with a small quantity of potassic) represent 21 per cent. of the quantity imported and 16 per cent. of the cost.

Through the kindness of the sugar estate proprietors, the Department of Agriculture has been supplied with details of the fertilizers used on the major portion (51,700 acres) of the sugar lands during 1933. The data presented in Table IV summarise the information supplied.

TABLE IV.

Fertilizers used on the Principal Estates in British Guiana, 1933.

Fertilizer	Quantity		Value		
	Tons	Per cent. Total	$	Per cent. Total	per ton $
Sulphate of ammonia	7,015.21	70.7	275,973.89	52.1	39.34
Superphosphate of lime	1,002.60	6.7	26,212.45	7.4	26.14
Basic slag	1,249.05	7.8	30,453.02	9.3	24.38
Sulphate of potash	150.35	2.5	9,767.73	1.1	64.97
Amophos	1.00	—	69.02	—	69.02
Plutophos	0.45	—	17.63	—	39.18
Barbados lime	3,129.85	9.8	38,263.01	23.2	12.23
Pulverised limestone	924.50	2.5	9,619.38	6.9	10.40
Totals for estates considered ...	13,473.01	100.0	$390,376.13	100.0	

FERTILIZER VALUES.

It will be seen from Table I that the total value of fertilizer imported in any one year has varied from a minimum of $351,000 in 1932 to a maximum of $2,176,000 in 1920. The mean annual figure for the period was $710,500. Approximately nine-twelfths of this amount is spent on nitrogenous fertilizers (sulphate of ammonia in particular), two-twelfths on phosphatic and potassic fertilizers, and one-twelfth on lime and limestone.

The price per ton of all fertilizers averaged as low as $23.00 in 1932, and as high as $114.00 in 1920, with a mean of $52.98. From 1910 to 1915 prices ranged between $45 and $50 per ton, then there was a period of high prices from 1916 to 1923. The drop which set in about that time has persisted, and planters in recent years have had to pay only from 50 to 70 per cent. of the average price paid in 1910-1914. It will be seen from Table III that it is mainly the falling off in the price of nitrogenous fertilizers which has caused this general drop in prices, but it is also partially due to the increased use of lime, a cheaper product, at the expense of more costly fertilizers. The value of the drop in prices to the local sugar industry is clearly seen in Table V. Whereas in 1910-

TABLE V.—Purchasing Power of Sugar in Relation to Fertilizers in British Guiana.

Year	Fertilizer (all kinds) Imported, Tons.	Sugar Required to Purchase Year's Imports of Fertilizer, Tons.	Ratio : Total Fertilizer Values ÷ Total Sugar Values.
1910	15,348	14,156	0.140
1911	12,827	10,060	0.102
1912	11,625	8,991	0.115
1913	14,949	10,433	0.119
1914	12,780	8,369	0.078
1915	16,543	9,117	0.078
1916	17,747	9,797	0.096
1917	13,089	10,727	0.094
1918	10,864	10,374	0.110
1919	11,246	6,833	0.082
1920	19,030	9,057	0.108
1921	9,384	9,525	0.088
1922	9,632	6,826	0.075
1923	11,909	5,961	0.072
1924	13,895	6,559	0.076
1925	13,138	8,407	0.086
1926	11,569	6,695	0.079
1927	14,649	6,595	0.060
1928	12,764	6,322	0.055
1929	12,224	7,698	0.077
1930	12,585	8,574	0.075
1931	13,630	8,193	0.069
1932	15,279	7,470	0.054
1933	15,367	8,464	0.067

1914 the total value of the fertilizers imported represented well over 10 per cent. of the value of the sugar exported, in 1928-33 it only represented 6·6 per cent. Expressed differently, it took an average of 7,787 tons of sugar to buy the fertilizers imported each year during 1928-33 as against 10,402 tons of sugar per annum for substantially the same quantity of fertilizers in 1910-14.

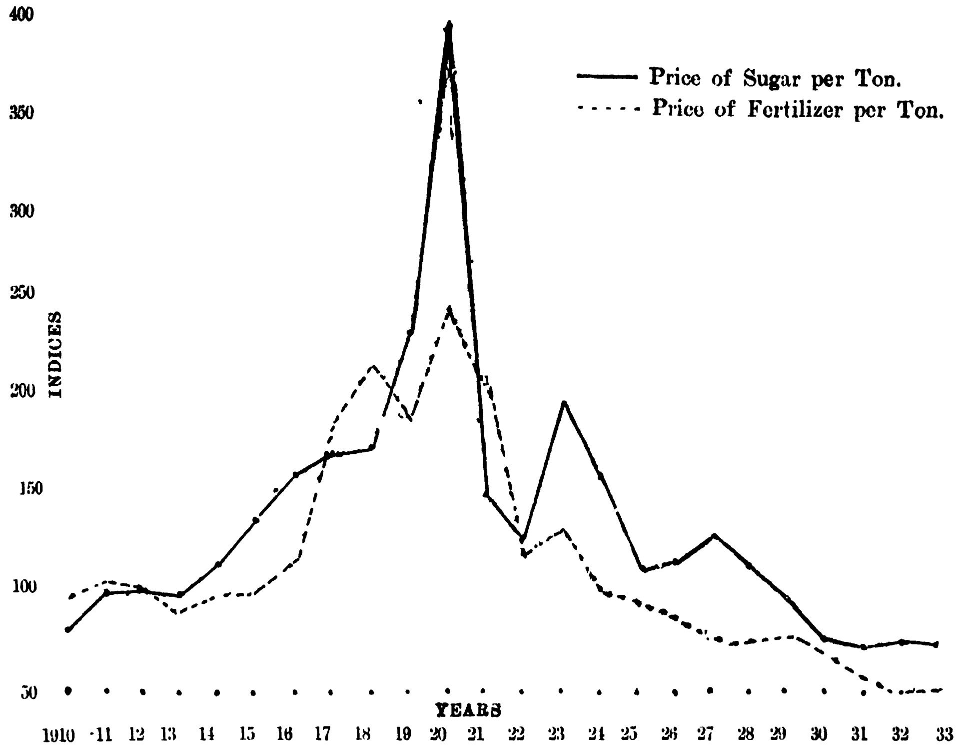

FIG. V. Prices per ton of sugar and fertilizers in British Guiana.

As will be seen from Figure V, fluctuations in the price per ton of sugar have been faithfully reflected by fluctuations in price per ton of fertilizers. The positive correlation (with secular trend eliminated) between price per ton of sugar and price per ton of all fertilizers is statistically very significant (correlation co-efficient + .93). The corresponding correlation between the index price of agricultural produce and that of fertilizers in England for the period 1921-32 is also significant (a correlation co-efficient of + .81). It is interesting to note that the correlation between price per ton of sugar and price per ton of fertilizer in British Guiana (+ .93) is higher than the correlation between fertilizer prices in British Guiana and in England (+ .87). There is no significant correlation between either the quantity of fertilizers imported and the value per ton of sugar, or between the quantity of fertilizers imported and their cost per ton.

In the course of a recent lecture before the *Conservatoire National des Arts et Métier* Monsieur Lheure, in discussing the situation of nitrogenous fertilizers in France, gave comparative prices (expressed in gold francs) of sulphate of

ammonia, nitrate of soda and wheat for the years 1911-13 and 1920-33. Figures VI and VII show that there has not been, in France, the same close relationship between the price of the agricultural product and the price of ferti-

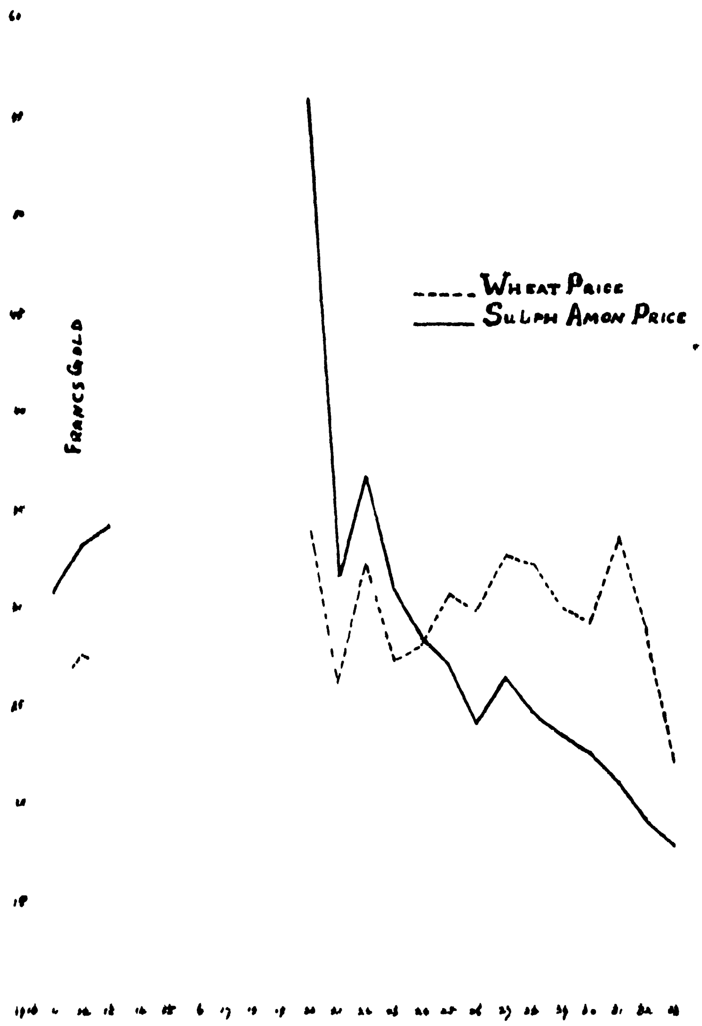

Fig. VI. Prices (in gold francs) of wheat and sulphate of ammonia in France.

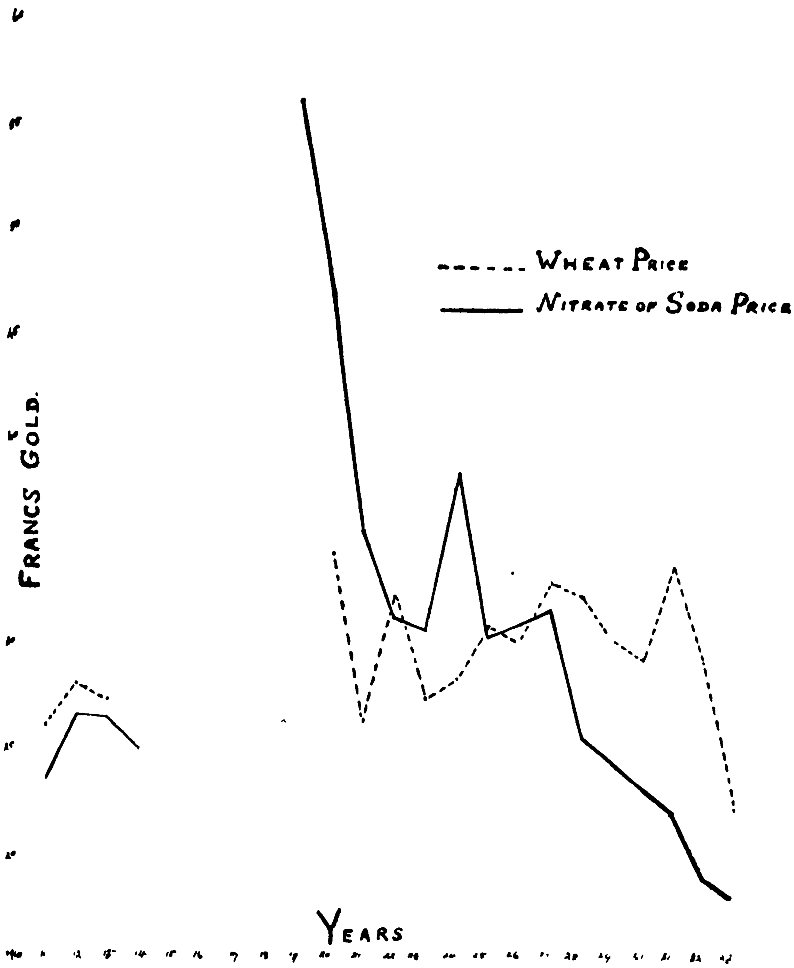

FIG. VII. Prices (in gold francs) of wheat and nitrate of soda in France.

lizers as there has been in England and British Guiana. Whereas in the two last instances the positive correlation has been high and very significant, in France there has been no significant correlation at all.

SOURCE OF FERTILIZERS.

Table VI shows the source of British Guiana fertilizer imports as given in the Customs returns. Unfortunately, these have not been uniformly kept, imports being listed in earlier years by countries whence consigned, and in more recent times by country of origin. It is gratifying to be able to note that the

TABLE VI.—Distribution, by supplying Countries, of Annual Costs of Fertilizer Imports in British Guiana.

Year	Great Britain, %	Canada, %	British West Indies, %	U.S.A., %	Continental Europe, %	Miscellaneous, %	Remarks.
1913	94.41	1.66	1.38	1.68	0.87		
1914	94.35	1.19	1.54	1.18	1.74		
1915	93.57	1.14	3.47	1.82			
1916	90.62	1.56	3.04	4.78			
1917	47.36	6.72	5.05	24.50		16.37[1]	
1918	49.14	22.07	4.40	24.30		0.09[1]	[1]Chile.
1919	49.84	29.02	4.50	16.55	0.09		
1920	66.93	19.81	6.81	6.29	0.16		
1921	81.60	9.95	2.44	4.00	2.01		
1922	81.14	8.63	3.17	4.21	2.85		
1923	89.89		3.07	1.24	5.80		
1924	87.95	2.21	4.64	1.31	3.60	0.29[2]	[2]Dutch West Indies.
1925	75.51	4.07	6.14	3.27	11.01		
1926	39.97	19.69	7.38	24.67	8.29		
1927	48.41	2.24	7.71	28.92	11.34	1.38[3]	[3]Peru.
1928	75.21		9.22	3.55	12.02		
1929	73.44	5.04	5.72	4.51	11.29		
1930	62.63	12.21	6.66	1.14	12.57	4.79[4]	[4]British East Indies.
1931	68.64	3.45	9.02	2.33	16.56		
1932	73.77		12.00	.04	14.19		
1933	72.04	3.24	11.19	1.19	12.34		

imports from British Empire sources have, during the past 21 years, always exceeded 58 per cent., and have only dropped below 80 per cent. on four occasions. In general, sulphate of ammonia comes from the United Kingdon, lime and limestone from the British West Indies, potassic fertilizers from Germany, basic slag from Belgium, and superphosphate of lime from Holland and Belgium.

SUMMARY.

Fertilizers are used in British Guiana only in the production of sugar cane, sulphate of ammonia being the principal kind used. All fertilizers are imported, not even lime being obtained at economic prices locally.

If the acreage in cane for the period 1910-13 is taken as 100 and the exports of sugar for the same period is taken as 100, then in 1930-33 the acreage would have fallen to 88.5 but the sugar exports would have risen to 136.6. In other words, although the area has decreased the yield per acre has improved sufficiently to increase the exports by nearly 40%.

The statistics for the quantity of fertilizers entering the country indicate that the long-time trend (for the period 1910-33) has been slightly to reduced (1.5% per annum) imports, but from 1930 an upward trend has been consistently maintained. There has been a marked increase in the imports of lime-bearing products from 1921, the quantity imported during 1931-33 being two and a half times that in 1913-15. Both price of sugar and price of fertilizer have fallen but the chief factor affecting fertilizer imports is found to be the area in sugar cultivation, and it has further been found that such imports are not materially affected either by price of sugar or by price of fertilizers.

In considering this last point, however, it must be borne in mind that while the quantity of fertilizer imported has not changed materially, the composition of the imports has varied, more lime being now imported than formerly. It should therefore be pointed out that falling sugar prices in recent years have been associated with the use of increasing quantities of low priced fertilizers at the expense of more costly types.

There is a remarkably high association between fluctuations in the f.o.b. sugar prices and the c.i.f. fertilizer prices (Georgetown)—a correlation co-efficient of +.93. A high correlation was found to exist between fertilizer prices in England and fertilizer prices in British Guiana, but a still higher correlation was found to exist between fertilizer prices in British Guiana and sugar prices in British Guiana. Further, the latter correlation was found to be higher than the correlation between the price of fertilizer in England and the price of agricultural produce in England, while no significant correlation has been found between price of wheat in France and price of sulphate of ammonia or nitrate of soda in France. This high degree of association between fertilizer prices in British Guiana and sugar prices in British Guiana may be considered remarkable.

THE CHEMIST AND ECONOMY IN THE PRODUCTION OF SUGAR

BY

J. F. WILLIAMS, A.I.C.T.A., DIP. AGR.

In this article the writer has endeavoured to present a brief review of the duties of a chemist on a sugar estate, to give a general conception of the scope of a chemical control in field and factory which has for its object the lowering of costs of production, and finally to suggest a few lines, along which, from the chemical viewpoint, further investigations could be carried out in British Guiana, particularly with regard to field technique. The importance of chemical control in the production of sugar has for a long time been recognised and now there are few sugar centres unprovided with a chemical staff, or in the case of small units, without the part-time services of a consulting chemist. Until recently, however, the greatest amount of attention was given by chemists to the manufacture of sugar from the cane and it is no doubt partly due to this that factory processes have attained their present-day level of efficiency.

Mention may be made at this point of the considerable improvements resulting from the introduction of electrometric pH control, also of the recent advances in pan-boiling consequent upon the adoption of conductometric or refractometric methods of control, which have placed a process at one time dependent on the skill and rule-of-thumb methods of native pan boilers upon a definite scientific basis.

The losses of sugar taking place in the process of manufacture have, therefore, been cut down to a considerable extent, and now more and more attention is being given to the production of sugar in the field and the losses that are liable to take place therein. Of the many factors affecting the yield of sucrose per acre, those of immediate concern to the chemist are the manuring and maintenance of fertility of the land and the ascertaining of the time when the cane has attained maximum "ripeness".

Manurial control.—The large volume of work on the manurial requirements of cane soils has emphasised the diversity of results obtained in different parts of the world and even on different types of soil in the same country, so that the solution of all problems relating to soil fertility must be distinctly localised. It is unnecessary to stress the desirability of soil investigations in any agricultural enterprise, but the estimation of the nutrient status of the soil by chemical analysis in conjunction with well designed field experiments as a guide in the choice of fertilisers and their most economical rates of application would be greatly effective in maintaining yields and reducing expenditure. Although chemical

analysis of soil for revealing nutrient deficiencies is most often used, with satisfactory results, the recent methods[1] of Mitscherlich (pot tests) and Neubauer (seedling tests) are rapidly gaining in favour in the Continent and have been used successfully in Hawaii. The writer hopes at some time to be able to investigate the applicability of these methods using sorghum and rice as indicator plants.

Return of waste residues.—The return of everything originally produced from the soil except the commodity which is being marketed is a well established principle of agriculture, to the observance of which is attributed the long-continued productivity of the soils of Europe and Asia. The following table, given by Deerr,[2] shows the average amounts of plant food removed by the cane crop, and their distribution in the various by-products.

Lbs. per 1,000 tons of Stalks.

	Lime.	Potash.	Phosphoric Acid.	Nitrogen.
Leaves, Tops, Roots.	2000	7500	1100	2500
Stalks	500	3000	1000	1000
Sugars	50	550	15	50
Molasses	250	2150	95	250
Bagasse	50	300	100	100
Press cake	750	—	790	600

These figures show that the greater proportion of the material removed from the soil is contained in the leaves, tops and roots, and this, of course is returned to the land in the usual course of cultivation. It is also seen that the cane is a heavy potash feeder, and that about two-thirds of the potash entering in the factory in the stalks is found in the molasses. That portion of the bagasse ash which is recoverable is taken back to the fields; a large amount of potash from the bagasse, however, appears as furnace slag and in this form is useless as a fertiliser. The value of press cake, which is fairly rich in phosphate, is offset to some extent by the difficulty of distributing in the field; in some places the cake is worked up with water in a mixer to a thin paste which is then applied to the row by tank cars ; a more feasible method for local conditions would be to allow the cake to dry in the open followed by pulverising; when applied in this pulverised form a more thorough admixture with the soil is possible. Molasses has been used as a fertiliser in many countries; its value lies not only in its content of potash and other mineral matter but in its ability to supply humus to the soil. It may, however, be more economical to produce rum or industrial alcohol from the molasses and then to return the lees to the soil. Many years ago a lees irrigation plant was installed on a Demerara estate which only operated for a short time prior to destruction by fire of the distillery. This system is not very often used owing to difficulties of operation and the objectionable odour of decaying lees. The use of Porion's open flame oven for concentrating lees and producing a charred product offers a more satisfactory means for disposal of distillery slops,

[1] Imperial Bureau of Soil Science Tech. Communication No. 25.
[2] "Cane Sugar". p. 99.

and it is suggested that some such process may be established locally, possibly utilising flue gases for heating. 100 tons of molasses, after being fermented and distilled is said to produce 4 to 4½ tons charred slop having about 40% potash, using Porion's oven. Assuming the price of sulphate of potash to be about $75 per ton, this material would be worth about $60 per ton.

Green Manuring.—The advantages of green manuring, especially with leguminous crops which are capable of fixing atmospheric nitrogen in the soil for the use of the succeeding crop are universally recognised in all phases of agriculture; the practice, so far as sugar cane is concerned, is carried out most extensively in Mauritius and Louisiana. In Louisiana the land is usually sown with cow peas (*Vigna unguiculata*) and the crop is either ploughed into the soil or cut above ground for use as fodder. According to Stubbs, when the crop is ploughed in, an average increase over plant and first ratoon cane of 7.42 tons per acre is obtained over that secured when the crop is removed for fodder, and the amount of nitrogen afforded by the crop of cow peas is about 100 lbs. per acre. De Sornay, after detailed study of green manuring in the tropics, arrived at the following results.[1]

Weight of Crop of Green Manures.

Plant.	Weight of green crop lbs. per acre.	Nitrogen in green crop lbs. per acre.
Cow peas (yellow)	50,200	190
Cow peas (grey)	51,000	219
Jack bean (*Canavalia ensiformis*)	28,000	210
Bengal bean (*Stizolobium aterrimum*)	42,000	210
Phaseolus lunatus	23,100	83
Phaseolus helvolutus	42,600	226

It is suggested that green manuring should be given a trial locally on pegasse lands the flood-fallowing of which is both expensive owing to the porous nature of the soil and the necessity for continual pumping of water, and ineffective as compared with the results obtained on front-land clays. A crop capable of affording a rapid cover such as Bengal beans or Canavalia should be sown after taking off the second ratoons and allowed to grow for a few months after which it should be turned under with a disc plough and the land left for a month or so before replanting with cane tops.

Less common elements in soil.—Pegasse soils consist chiefly of plant residues decayed under water-logged conditions, somewhat similar to peat soils, and are very deficient in plant nutrients. There is also the possibility of a lack of one or more of the less common elements such as copper, manganese or boron which in minute amounts appear to be necessary for plant growth. Thus in the Florida Everglades marked response in the growth of cane followed the application of copper and manganese sulphates, and now manuring with these salts forms part

[1] Deerr—"Cane Sugar" p. 97.

of the agricultural routine in that State.[1] The writer is carrying out qualitative tests with copper and manganese sulphates applied at the rate of 28 lbs. per acre to a few rows in a field of pegasse, the growth of cane in which was very poor; the present appearance of those canes treated with copper sulphate is such as to render more extended trials with this material desirable.

Pre-harvest sampling of cane.—The methods employed in sampling a field of cane in order to determine the degree of maturity vary considerably from place to place; in fact, it is almost impossible to secure a moderate-sized sample that will be fairly representative of the whole field, and the best the chemist may hope to accomplish is to obtain a sample that will indicate the general condition of the cane. A greater variation occurs beween stalks of a different age in the same stool than between stalks of the same age in different parts of the field, and the method most often recommended is to secure several complete stools from various parts of the field: the bulk sample so obtained is reduced to one of suitable size after thorough mixing by some system of sub-sampling. Considerable improvements in sampling technique have followed the introduction of the hand refractometer; by using this instrument it is only necessary to withdraw a few drops of juice from the stalk, so that it becomes possible to examine a large number of canes in a field. The figures given by the refractometer represent the percentage of dry substance in the juice (Brix) which has been shown by Moet[2] in Java to be closely correlated with the content of sugar. Alamo[3] found that for a given variety of cane the difference between there fractive Brix of juice from the third internode from the base of the stalk and that of juice from the second coloured internode at the top stands in close relation to the state of maturity of the cane, and at maturity this difference disappears; in over-ripe cane the difference is negative. In this manner the course of ripening may be followed, and the chemist will be able, by experience, to forecast the time when the maximum sugar content of the cane is likely to occur.

Losses of sugar in the field.—Apart from the damage done by borer infestation and other pests and diseases, considerable losses of sugar are caused by deterioration after cutting and, to a lesser extent, by the presence of "tops" on the cane sent to the mills.

Deterioration of cut cane.—Many experiments have been carried out on the deterioration of cane after cutting under various conditions and all results point to the increasing rate of loss of available sugar for the first few days. The following data were obtained by Scott[4] in Trinidad:—

[1] Allison—Proc. 4th. Cong. Int. Soc. Sug. Cane. Tech. Bull. No. 112 (1932).

[2] Arch Suckerind *42*, I, 193.

[3] Proc. 4th. Cong. Int. Soc. Sug. Cane Tech. Bull. No. 109, (1932).

[4] Trop. Agr. 1926, 35.

Cane, hours cut.	Yield 96° Sugar % Cane.	Loss in available Sugar %.
Fresh	14.05	—
24 hours	13.24	5.77
48	12.99	7.55
72	12.06	14.16
96	11.68	16.87
144	10.31	26.62

Greater losses are found to occur when the cut cane is exposed to the sun than when kept covered, and this should be borne in mind when punt loads of cane have to be kept some time in the factory dock. Different opinions appear to be held on the effect of burning before cutting; Dodds and Fowlie[1] found that unburnt cane deteriorated more rapidly than when burnt, especially if in the latter case the cane is left standing, but Spencer[2] states that burning tends to accelerate deterioration, particularly in wet weather. Carefully controlled experiments on this question would furnish information of great interest to local estates; it is apparent, however, that every attempt must be made to cut and transport cane to the mills as soon after burning as possible.

Improperly topped cane.—That further losses of available sugar are caused by the presence of tops on the cane sent to the factory is shown by the following figures presented by Scott[3].

Sucrose % cane.		Juice Purity.	% Weight	Tons cane per ton Sugar.
Tops only	4.17	44.39	11.84	—
Topped canes	12.71	84.50	88.16	8.72
Whole canes	11.65	82.22	100.00	10.34

Thus the tops (green "cabbage" and white joints) representing 11.84% of the weight of cane were responsible for an increase of $\frac{(10.34-8.72)\times 100}{8.72}$ or 18.58% in the tonnage of cane required to produce a given quantity of sugar, and so while themselves producing no sugar, tops cause a loss of available sugar contained in the richer part of the cane. Efficient organisation and careful supervision in harvesting are therefore of the greatest importance in maintaining the economy of field production.

Another point which should be investigated on similar lines is whether a loss of available sugar ensues by grinding "water cane," *i.e.*, cane which has fallen into the canals and which has undergone considerable deterioration after several days' submergence in water.

[1] South African Sug. Jour. 1929, 287.

[2] "A Handbook for Cane Sugar Manufacturers and their Chemists" p. 10.

[3] Trop. Agr. 1926 p. 235.

Factory control.—Only brief mention will be made here of the functions of the chemist in the factory; as rigorous a chemical control as conditions will permit should be established in order to guide the processes of manufacture along the lines of best practice. Factory control essentially consists of the weighing or measuring, sampling and analysis of the materials and products in the various stages of manufacture so as to form a balance sheet showing the amount of sugar entering in the cane on the one hand and the amount recovered in the processed product on the other, together with the amount lost in the bagasse, press cake, molasses and in other "undetermined losses". The chemist should endeavour to minimise, as far as is economical, unavoidable losses in bagasse, press cake and molasses; to locate and eliminate, if possible "undetermined losses" in which are included losses by inversion and evaporator entrainment; to check the proper and economical operation of the various units, including the furnaces and boilers; to study the many problems peculiar to each individual factory and to suggest means for their solution ; and to maintain the quality and uniformity of the product. The chemist is also the statistician of the factory and must report on the quantity and analysis of raw materials, products and by-products and submit all data having a bearing on the control and economy of the sugar house.

INCREASED YIELDS OF PADI OBTAINED BY DOUBLE TRANSPLANTING.

BY

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Plant Breeder, Rice Experiment Station

An interesting deviation from the normal method of transplanting padi was recorded recently by Sengupta.[1] It is stated that the rice cultivators of the Goalpara district of Assam have for generations adopted the practice of transplanting their seedlings twice, by which process they claim, among other advantages, an increase of 30% in yield. Briefly, the method adopted is as follows :— The seedlings are lifted from the nursery about 25 days after sowing and transplanted in sets of two to four seedlings per set at rather close spacing. About 25 days later, the seedlings are again lifted and transplanted into the field in the normal manner.

Experiments carried out by Sengupta demonstrated that double transplanting increased the yield of padi considerably. A more elaborate trial has just been concluded at the Georgetown Rice Experiment Station to test the merits of the above process, and also to discover the optimum ages at which the first and second transplantings of the seedlings should be done. Six treatments were decided upon as follows :—

1. Single Transplanting at 4 weeks from date of sowing.
2. Single Transplanting at 5 weeks from date of sowing.
3. Double Transplanting, first at 3 weeks, second 3 weeks later.
4. Double Transplanting, first at 3 weeks, second 4 weeks later.
5. Double Transplanting, first at 4 weeks, second 3 weeks later.
6. Double Transplanting, first at 4 weeks, second 4 weeks later.

The experiment was arranged in the form of a 6 x 6 Latin Square, the individual plots being 1/80th of an acre in extent, and all plots were surrounded by strips to eliminate border effect. Seed of the variety *No. 79* was sown in the nursery on April 4th. Treatments 1 and 2 were planted direct into the experiment on May 22nd and 28th, *i.e.*, 32 days and 38 days respectively after sowing the seed, in the customary manner. In the case of treatments 3 and 4, a bed in an adjacent field was planted at approximately 5 x 5 inch spacing on May 14th, (24 days after sowing). These seedlings were lifted on June 5th and 11th to plant treatments 3 and 4, respectively. It was found that each of the sets could be split into three or four lots for the second planting, so that one square rod of the secondary nursery was sufficient to plant six square rods in the field. Treatments 5 and 6 were planted in a similar manner. The dates of the several plantings are summarised below :

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[1] Agriculture and Livestock in India, 1933 : III : 465—469.

TABLE I.

Treatment.	Date seed sown in nursery.	Date of first transplanting.	Number of days from date of sowing.	Date of second transplanting.	Number of days from date of second transplanting.
1	April 21	May 22	32	—	—
2	„ „	„ 28	38	—	—
3	„ „	„ 14	24	June 5	22
4	„ „	„ 14	24	„ 11	28
5	„ „	„ 22	32	„ 11	20
6	„ „	„ 22	32	„ 18	27

The mean yields of padi obtained, expressed in lbs. per acre and in bags of 140 lbs. per acre are set out below :

TABLE II.

Treatment.	Mean Yields of Padi		Percentage of Mean.
	lbs. per acre.	bags per acre.	
6	3597	25.7	110.4
5	3523	25.2	108.1
4	3273	23.4	100.4
3	3170	22.6	97.3
1	3000	21.4	92.0
2	2990	21.3	91.7
Significant Difference ($P=0.05$)	365		11.3

It will be seen that the double transplanting (Treatments 6 and 5) gave a significantly higher yield than the single transplanting, the increase in yield being approximately four bags per acre. The highest yield was obtained by transplanting first when the seedlings were four weeks old and again four weeks later.

Throughout the experiment, Treatments 5 and 6 exhibited the healthiest appearance. It was observed that the second pulling and splitting of the clumps checked excessive tillering, but further investigation is being carried out to determine the exact reasons for the increased yield.

Before considering the additional costs incurred by double transplanting, the various operations entailed in cultivating one acre of land by this process are outlined :

(1) Sow sufficient seed (approximately 12 lbs.) in the nursery in the customary manner.

(2) Carry out first transplanting of the 1/5th acre 4 weeks after the seed has been sown in the nursery.

(3) Carry out second transplanting at 8 weeks from date of sowing or 4 weeks after first transplanting.

It may be pointed out that whilst the seedlings are developing after the first transplanting, the remaining 4/5ths of the acre should be ploughed. The additional costs involved are as follows :—

(1) Transplanting one-fifth of an acre at 5 x 5 inch spacing, approximately $1.00.

(2) Pulling and splitting the clumps. The seedlings could be pulled by one man at a cost of 50 cents while the latter process could be done by the women employed in transplanting.

(3) Additional hoeing of the one-fifth of an acre before it is planted for the second time, say 30 cents.

The total extra cost would be approximately $1.80, so that an increase of four bags per acre is definitely profitable.

SUMMARY.

1. The experiment has successfully demonstrated that it is possible to obtain considerable increases in yield of padi by double transplanting.

2. The additional expenses incurred are more than counterbalanced by the increase in the yield of padi.

3. Double transplanting results in stronger seedlings, more efficient weed control and a considerable saving in seed.

SELECTED ARTICLES.

A NOTE ON THE FORESHORE VEGETATION IN THE NEIGHBOURHOOD OF GEORGETOWN, BRITISH GUIANA, WITH ESPECIAL REFERENCE TO SPARTINA BRASILIENSIS*

BY

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CONTENTS.

INTRODUCTION.

Rapid silting and the consequent recent formation of a foreshore, which has quickly become covered with vegetation, has been the object of some observations made by the writer in the neighbourhood of Georgetown, British Guiana. Before describing the vegetation in any detail, however, it may be as well to give a short account of the coast as a whole and of the factors concerned in the recent making up of the foreshore on parts of it.

*Reprinted from the Journal of Ecology, Vol. XXII. No. 1. February, 1934.

The Coast. The coast of British Guiana consists of a flat alluvial plain, laid down through the course of ages by the deposition of sea-borne clays, the greater part of which are considered to have originated in the effluent of the River Amazon, and to have been carried to their present site by the prevailing currents of the Atlantic. This plain extends inland for a distance varying from 10 to 40 miles before rising to any extent above sea-level, and it is traversed by several rivers. Large areas near to the sea are below spring tide high-water level and are therefore liable to constant flooding. Narrow sand reefs here and there mark the sites of earlier shore-lines.

Before the advent of the early settlers, the whole coast was fringed by a belt of mangrove[1] swamp, behind which lay swamp savannahs, usually flooded, and occupied by sedges and numerous aquatic plants, *Mauritia flexuosa*, the "Aete Palm", being scattered throughout. As the level became slightly raised, a low type of swampy forest occurred. All these types of vegetation may be found to-day over large areas of the coastal plain, but since the advent of European settlers in the early part of the seventeenth century, this coastal belt has become the principal seat of agriculture, proving eminently suited to the cultivation of sugar, cocoa and other crops, including, more recently, rice. As a consequence, its vegetational aspect has been largely altered by the hand of man.

The early colonists were chiefly the Dutch, who, finding themselves in a country the physical features of which closely resembled their own home, adopted similar methods for the reclamation of land to those in vogue with their kinsmen in Holland. These methods are maintained in principle to the present day. The area of land to be "taken in" is "empoldered", *i.e.*, surrounded by a dam to keep out water from the landward side, and a sea wall is built to protect it from the ocean (or river). The area so cut off is intersected by irrigation and drainage trenches, and drained by means of a "koker" or sluice in the sea wall, which is opened as the tide falls. Behind the sea wall, conditions are therefore artificial: outside it, a natural foreshore may be formed.

The Foreshore. Owing to frequent changes in the currents, the actual shore-line of the coast is constantly varying from point to point. In one section high tides may be menacing the sea defences, whereas a few miles farther along silting is taking place, resulting in the deposition of a new area of foreshore. As the currents change again, the newly formed land in turn becomes subject to erosion, and so the fluctuation continues. On such muddy areas, outside the sea wall, a "mangrove" association soon becomes established, in which *Avicennia nitida* (known locally as "Courida") usually predominates, intermixed with *Laguncularia racemosa*. *Rhizophora* spp., though dominant on the lower reaches of the rivers, are not so plentiful on these quickly formed areas of foreshore. Where mud is being rapidly deposited, however, it is to be observed that on parts of the coast *Spartina brasiliensis* Raddi plays a very considerable part in the primary colonisation of the rising mud banks. Owing to its similarity to

[1] The term "mangrove" as used throughout covers the several constituents of this association, including *Rhizophora* spp., *Avicennia nitida* and *Laguncularia racemosa*.

FIG. 1. A general view of the foreshore from the sea wall. Sandy beach with *Ipomoea biloba* in foreground. "Lagoon" and grazed mangrove bushes behind the groyne in the middle distance: mud bank and belt of young mangrove in the background.

FIG. 2. Part of the mangrove belt, with *Spartina* in the foreground.

Journal of Ecology, Vol. XXII, Pl. 25, by courtesy of the Editor.

S. Townsendii, which has of recent years attracted so much attention as a coloniser of muddy foreshores in European waters, a description of the succession that occurs in the building up of the foreshore association on parts of this coast may be of interest.

The formation of the Foreshore. The manner in which the foreshore is laid down outside the sea wall is worthy of note, because not only does it decide the distribution of the societies within the association, but it also repeats, on a small scale, the process by which the whole coastal plain must have originally been formed.

Where rapid silting is taking place, the greater part of the foreshore laid down consists of soft mud, which is deposited to form a bank stretching out from the sea wall. With the receding ebb tides, however, a certain amount of "washing" occurs in places at the foot of the wall, resulting in the formation of a shallow channel between the wall and the mud bank. This channel may in time be obliterated by mud being pushed over it, or may eventually form a sort of miniature "lagoon" behind the broadening mud bank. In addition to the mud, however, sand constitutes an important factor in these areas. Sand and broken shell from banks a short way out to sea are brought in by spring tides and wave action, carried over the mud bank and deposited in shore. The ultimate result is the formation of small sandy beaches at intervals along the sea wall, and the admixture of a quantity of sand and shell with the mud in the "lagoons" behind the mud bank, giving the mud there a much firmer consistency.

The area under observation. The portion of the coast on which these observations were made is a stretch some 10 miles in length, immediately to the east of Georgetown and the mouth of the Demerara River. In 1915 the sea defences on this frontage were seriously threatened, as a result of which the sea dam was strengthened by a concrete wall, and groynes constructed to encourage silting. Subsequently, considerable silting has taken place, increasing in amount during recent years, and resulting in the deposition of a muddy foreshore, with a covering of vegetation, that stretches out from the sea wall for a distance varying from 100 to 300 yards.

THE VEGETATION OF THE FORESHORE.

(Pl. IV, Fig. 1.)

The "foreshore association" consists of three societies, dependent upon three different types of habitat, which may be dealt with separately. These, as explained above, are

(a) The *mud banks* to seaward;
(b) The *sandy "beach"* at the foot of the sea wall;
(c) The intermediate "*lagoons*".

The Mud Banks (Pl. V. Fig. 3). These consist of soft mud, and their level gradually rises with continued deposition of silt. At first only exposed at low tide, as the level rises the highest contour is covered by spring tides alone. If the bank continues to the foot of the sea wall, the highest level is found here. If, however, a "lagoon" intervenes, the mud bank forms a ridge a little way out from the wall.

The mud is deposited more or less evenly, but as the level rises the retreating waters of the ebb tide carve out a network of small channels, leaving islands of mud between. On these islets, *Spartina brasiliensis* gains a footing, either becoming established by portions of the plant, capable of vegetative reproduction, which are washed up from elsewhere, or by seedlings. Once established, with their system of surface feeding roots, deeper anchoring roots, and prolific production of stolons (Pl. V. Fig. 4), large clumps are soon developed. These raise the level of the mud and gradually unite, so that a little further inland the separate islets give way to an almost pure stand of *Spartina*, intersected here and there by channels, in which are scattered seedlings of *Avicennia nitida* and *Laguncularia racemosa*. By the time this stage is reached, the level of the mud has been raised so that the highest portion is not covered by normal tides, and a tide mark, indicated by a line of drift dèbris, becomes definable. At this high-water mark, seeds of *Avicennia* and *Laguncularia* are deposited in the greatest profusion, resulting in an increase in the number of these "mangrove" plants, either at the foot of the sea wall, or as a very distinct belt of bushes along the top of the mud bank ridge, on the seaward side of a "lagoon" (Pl. IV. Figs. 1, 2). Once established, these plants of the mangrove association climax grow very quickly[1], becoming dominant to the *Spartina*, which finally almost entirely disappears beneath them. Two biotic factors however may hinder the "mangrove" from attaining its maximum development. The first is the grazing of cattle and goats, etc., on the fóreshore. Where the mud bank is backed by a lagoon, the admixture of sand is such that the mud will support the animals' weight, and "mangrove" trees on the inland edge of the bank are kept closely grazed back, remaining as small squat bushes. In addition to this, as the trees on the mud bank itself reach a moderate size, they are cut back, both to supply firewood, and to control the breeding of mosquitoes.

The Sandy "Beaches". These form at the foot of the sea wall; they are at a higher level than the mud in front of them, and as the sea retreats are left above spring tide high-water mark. As a result the sand in course of time is leached. The surface of these higher beaches then becomes covered with a mat of *Fimbristylis spathacea*, over which run the straggling shoots of *Ipomoea biloba*. A few other grasses and sedges are to be found scattered on these ridges, including a fair amount of *Stenotaphrum secundatum*. Here and thére a small bush of *Jatropha urens* may be seen. In depressions which form at the foot of

[1] From one point on the sea wall (Ogle Koker) in 1929 the sea was plainly visible over a stretch of fore-shore covered with *Spartina* and scattered mangrove seedlings. At the time of writing, some three years later, a belt of mangrove, 15-20 ft. high, growing on the mud bank about 80 yards from the sea wall—a lagoon intervening—completely cuts off all view of the sea.

the sea wall, and collect rain water, *Fimbristylis spathacea* gives way to *F. diphylla*, and the aquatic grasses *Sporobolus virginicus* and *Paspalum distichum* occur, the latter being more prevalent where the water is least brackish. Cattle graze on these areas, and keep the grasses and sedges close-cropped.

The "Lagoons." These vary from large areas, 50 yards or more in width, between the mud bank and the sea wall, to small isolated patches. At high tide they may resemble true lagoons—but as the mud bank in front of them enlarges, they are left dry except by the spring "flood" tides. They are distinguishable at once by their bare appearance. The *Spartina* does not encroach on them, the mixture of mud and sand probably proving unsuited to penetration by the stolons: the surface quickly dries and cakes in the sun between tides, and the saline nature of the soil prevents the plants of the higher sandy beaches from spreading on to them. Finally, such plants as do become established, are liable to be grazed by cattle. On these bare places are to be found, spreading thinly, creeping stems of *Sesuvim portulacastrum* and scattered patches of *Sporobolus virginicus*. A few clumps of *Batis maritima* occur here and there, and isolated plants of *Avicennia nitida*, closely cropped.

On the landward side, if the level rises sharply, the change in vegetation is abrupt, a line of drift débris separating the bare lagoon from the sedge-covered "beach." To seaward, however, a more gradual transition takes place, clumps of *Sporobolus virgincus* intermingling with the *Spartina* for some distance out on the soft mud.

The following figures give an idea of the difference in soil constitution in the three types of habitat[1]:

		% of sand	% of salts
Sandy beach	Topsoil	88·7	0·082
	Subsoil	87·2	0·068
"Lagoon"	Topsoil*	61·7	0·986
	Subsoil†	86·0	0·645
Mud bank, composite sample		5·9	1·351

THE SPARTINA SOCIETY.

Comparison with Spartina Townsendii. The part played by *S. brasiliensis* in the primary colonisation of the newly raised mud bank is of interest for two reasons. In the first place, the appearance of a grass in this rôle would appear to be unusual in the tropics, where muddy foreshores are more unusually colonised directly by "mangrove." In the second place, its similarity in function and adaptability to *S. Townsendii* of European waters is striking.

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[1] I am indebted to Mr. C. L. C. Bourne, Assistant Chemist, Department of Agriculture, British Guiana, for these figures.

* Quantity of fine shell fragments removed before analysis.

† Large quantity of fine shell fragments removed before analysis.

Its rooting system and power of extension by means of stolons render it eminently suited to rapid growth in soft mud and, like its relative, it is able to withstand several hours' submergence. Perhaps not unnaturally, owing to its superficial resemblance to the crop, *S. brasiliensis* is also known locally as "Rice Grass" or "Wild Rice." There is one very noticeable difference from *S. Townsendii*, however, in that the leaves of *S. brasiliensis* are somewhat coarse and stiff and terminate in sharp needle-like points that make walking barefoot through the grass a painful business. Perhaps it is partly on this account that, although cattle do graze on it, the local grass is not so palatable as *S. Townsendii* appears to be. In addition, the softness of the mud, where Spartina grows thickest, also prevents it being grazed to any extent.

History of the Development of the Society. From an examination of earlier records of *S. brasiliensis* in the colony, it would appear to have been found originally on the banks of the Demerara River, near the mouth. Its mud-binding qualities in this locality were noticed at the beginning of the present century by a sugar planter who planted some of the grass on the muddy foreshore opposite an estate on the coast, east of Georgetown (Vryheid's Lust). There is a record of the grass extending for some 400 yards or so along the foreshore at this spot in 1908.[1] Subsequently, in 1915, erosion was taking place very rapidly on this part of the coast, and attempts were made to stay its course by the planting of various mud-binding species. One who assisted in these operations states definitely that the "Rice grass" was not to be found on this portion of the coast at the time. The sea was then seriously threatening the sea wall, and it is probable that the *Spartina* had been washed away. In order to check the sea's action, groynes were built to encourage silting, which has as a result continued steadily from about 1918 to the present day. At the same time fresh plants of *S brasiliensis* were obtained from the Demerara River and set out on the foreshore. From these beginnings the present large areas of the grass have arisen.

Experiments with S. Townsendii. A year or two ago, some plants of *S. Towsendii* were obtained from England for trial under local conditions. On arrival, they were divided into three lots and planted :

(a) On a rather sandy area submerged at every tide.
(b) On a more muddy "lagoon" area, only covered by spring tides.
(c) On a bare patch out on the mud bank, covered by every tide.

The plants on the sand soon died. Those on the second area survived for a year or more, but never became properly established, and were finally smothered under a pile of drift débris. But the eight plants originally put out on the soft mud on a plot about 6 x 6 ft. have grown and spread so that the whole plot is covered with a thick mat of grass, which is also spreading outwards. (One Courida seedling is to be observed in the centre of the plot). The close-cropped condition of the *S. Townsendii* suggests that goats have been able

[1] Journal of the Board of Agriculture, British Guiana, 1, 3, p. 5-1908.

PLATE V.

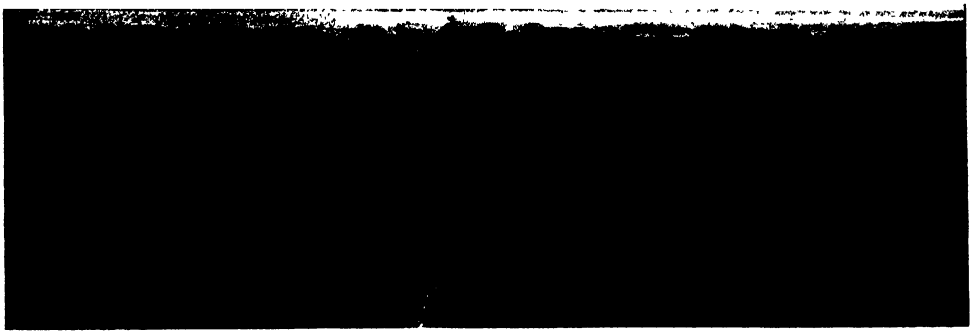

FIG. 3. The seaward edge of the mud bank. Primary clumps of *Spartina* in the background.

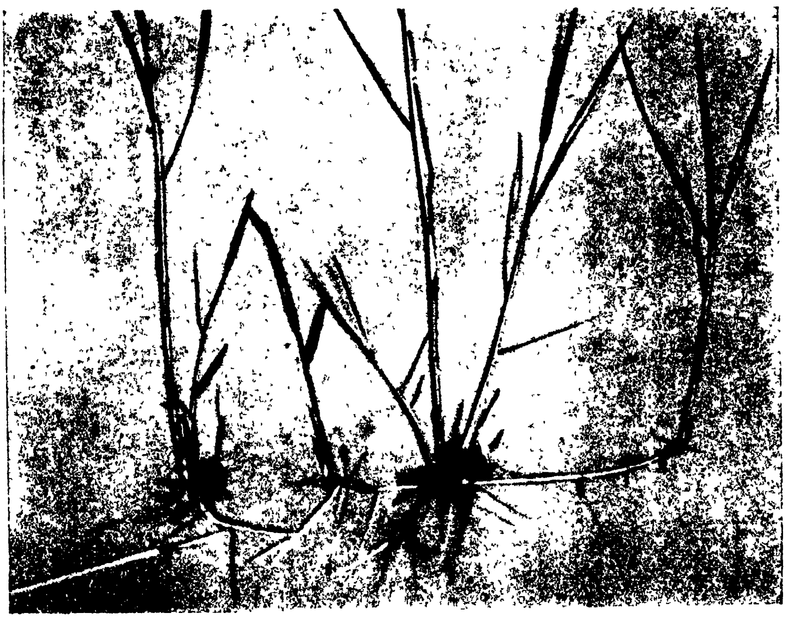

FIG. 4. Plants of *Spartina brasiliensis*, showing stolons, surface roots and anchoring roots.

to reach the plot at certain states of the tide, and have found this grass much more palatable than the local species. It would appear, therefore, that there may be possibilities for *S. Townsendii* on tropical shores in South America.

SUMMARY.

A short account is given of the coast of British Guiana, the main types of vegetation encountered there, and the modifications due to man's activities.

The rapid formation of new areas of foreshore as a result of silting is described, and an account given of the types of vegetation encountered thereon. The part played by *Spartina brasiliensis* in the primary colonisation of the newly raised mud bank is stressed, and this grass is compared with *S. Townsendii*. Mention is made of an attempt to establish *S. Townsendii* locally, and of the results obtained.

ACKNOWLEDGMENTS.

My thanks are due to Mr. L. E. Codd and Mr. C. L. C. Bourne of the Department of Agriculture, British Guiana, for assistance with the photographs and for partial analyses of the soils of the foreshore respectively. I am also indebted to Prof. F. W. Oliver for kindly sending me a quantity of literature on *Spartina* which would not otherwise have been available to me.

.. ..

The above paper having been written in 1932, some further developments have taken place, which it is of interest to place on record.

In the first place, the plants of *S. Townsendii* which made such a promising start on the soft mud, were subsequently completely smothered by the local Rice Grass, and two other plots set out further up the coast suffered the same fate. *S. Townsendii* is apparently not able to compete with *S. brasiliensis* when the two grasses occur together.

In conclusion, it is also noteworthy that the plant succession on a newly raised foreshore, described in the above paper, may now be followed step by step on the mud bank which has formed recently west of Kitty jetty.

PRACTICAL DUCK-KEEPING.*

BY

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In Queensland, ducks are chiefly kept for table purposes, although quite a number of small flocks are kept for egg production. There are very few specialised duck farms ; the usual practice is to keep a flock of ducks as a farm sideline. The market for table birds is usually kept fairly well supplied from existing sources, high values are therefore not regular. Reasonably high prices are, however, obtainable when the demand is firming for the Christmas trade. This fact indicates the necessity for a continuous supply of cheap food stuffs suitable for growing ducks destined for the table. The keeping of ducks for egg-production is not practised extensively in this State ; this is possibly due to the unpopularity of the duck egg, making it somewhat difficult to market. It is all a question of taste, for a duck egg is equal to a hen egg in food value, and, provided the birds are fed on good wholesome food and kept under strict sanitary conditions, it would be fairly difficult to distinguish any difference in general quality. Ducks are more prolific layers, have a longer profitable life, are more easily reared, and are freer from disease than other poultry.

The foremost breed is the Muscovy ; this bird is essentially a table bird, and may be found all over the State. The Muscovy is distinct from all other breeds of ducks and will always remain distinct, for if this breed is crossed with any other breed of ducks the progeny will be mule ducks.

THE MUSCOVY.†

General Characteristics.

The head is large, and at times it raises the feathers in fan shape ; the beak is thick, with a band of reddish colour, the nostrils and the face being covered by carunculated flesh ; the eye is brown ; the neck is thick and of a fair length. The body is a great frame, rectangular in shape and nearly horizontal, short and powerful in leg, with fairly large feet, webbed to end of toe with powerful claws. The male has no curled feathers in the tail, as other breeds ; his plumage is of a brilliant bronzy black, with a green sheen. Legs of both sexes are black to the toes.

The female is similar to the male, but only half the size, without the wrinkled flesh around face, and duller in plumage than the male.

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*Reprinted from "Queensland Agricultural Journal," Vol. XLII, Part 2.

†A corruption of "Musk Duck", native of South America—nothing to do with Muscovy (Russia).

Size.

The average weight of the drake is just over 12 lb., but many reach 14 lb. and over. The duck, however, is less than half the weight of the drake, and it is a very large duck which attains 6½ lb. the average being about 5 lb., The adult drake is enormous—measuring frequently 32 to 34 in. in length ; it walks slowly and heavily.

INDIAN RUNNER.

General Characteristics.

Of the egg-producing ducks, the Indian Runner predominates in numbers. But the Khaki-Campbell is becoming very popular and is equal as a layer, whilst it is slightly heavier in body weight than Runners.

Head.—Fine and somewhat flattened over the skull, with the eyes full, bright and clear, showing alertness, and situated high up in the skull. Bill strong and deep at the base where it joins and fits almost insensibly into the skull, and thence comes as nearly as possible straight down to the tip, giving it a wedge-shaped appearance of good average length.

(*Note.*—The shape is more important than actual length or width, and it should be proportionate to the build and size of the bird and well set into the head at the junction. Very flat or dished bills with rounded under-line are objectionable, and abnormally long heavy bills are liable to be accompanied with coarse heads and thick necks, which are serious faults.)

Neck.—Neck very fine, thin and slender to where it begins to form the expansion towards the base of the neck, which expansion should fit almost insensibly into the upper part of the body, so as to appear almost part of it, the head and neck carried high and slightly forward, and not curved or carried swan-like.

Body.—Body—the lower portion of the neck expansion is included—long and narrow, of nearly uniform thickness, very tightly feathered. Wings closely packed ; approximately about twice the length of the neck to the top of the head. When standing erect, the stern appears comparatively short and curves round to the tail, which is close and neat, and in the best specimens carried nearly in a line with the body, but in some excellent birds it is slightly elevated or turned upwards, and a fullness of the lower stern is frequent in the most prolific layers.

Legs.—Legs placed much farther back than in other breeds of domestic ducks. Shanks comparatively short, with small supple feet and strong thighs to enable the bird to balance properly and maintain an upright position when on the run.

Length and Size.—As layers of a great number of large eggs, substance and constitution are necessary in the breed ; small, square specimens are useless, while heavy bulky birds are less active as foragers and open to the same objections. A

medium size with good reach and perfect symmetry is advisable, but appearance and activity should be a truer guide than actual weight and measurements.

Carriage:—In comparison with other ducks, the body is more tightly feathered and appears longer and thinner, and this impression is heightened by the remarkable erect carriage and the fact that the bird when on the alert carries its neck and body almost in a line at an angle of from 50 to 70 degrees to the horizon. Its gait is peculiar in that it travels with a straight-out run and does not waddle or roll like the ordinary duck. In general appearance and shape when in motion, it has, not inaptly, been likened to a soda-water bottle set at an angle of 50 to 60 degrees, a character which is best seen in a front or semi-front view. When startled, standing at attention, or trained in the show pen, it assumes an almost perpendicular pose or attitude.

Weight.—Drakes, 3½ lb. to 5 lb.; length 26 inches to 32 inches. Ducks, 3 lb. to 4½ lb.; length 24 inches to 28 inches. The above are fair standard weights and lengths, but must count for nothing if not accompanied with type and well-balanced proportions.

There are three varieties—Fawn, Fawn and White, and the White.

THE KHAKI-CAMPBELL DUCK.

General Characteristics.

This is a moderately small breed, the body being wide and fairly deep, with slightly upright carriage and finely shaped head and neck. In the male the bill is green (the darker the better) the head, neck, stern and wing-bar bronze, and the rest of the body an even shade of khaki or dark buff, with dark orange legs and feet. In the female the bill is greenish-black, the plumage being khaki or dark buff all over, with even ground colours while the back and wings are laced with a lighter shade of buff, and the legs are dull orange, both bill and legs being several shades darker than in the drake. Lightish feathers in the wings are allowed, but white bibs are untypical, as are yellow bills. Khaki-Campbells are tame and tractable creatures, and prolific layers of white eggs.

Weight.—Both sexes, 4½ lb.

HOUSING.

The mild climatic conditions in Queensland obviate the necessity for the construction of elaborate or costly houses for the accommodation of ducks. That does not mean that ducks can be herded profitably in any class of a house. Houses should be built similar in design to ordinary poultry houses, a lean-to building facing north or north-east, open-fronted, with a ventilation space at the top of the back wall. Buildings so constructed will afford the ducks most protection against prevailing winds and rains whilst at the same time the sun's rays penetrate into the house.

Construction.—The building need not be deeper than 5 feet, and the roof could be 6 feet high at the front and 5 feet high at the back, and a ventilation space of 3 inches at the top of the back wall would be satisfactory. In estimating the size of the building, allow 2 square feet of floor space for each duck; thus a building 10 feet long and 5 feet deep will accommodate twenty-five ducks. The best materials for the construction of duck-houses is sawn hardwood and galvanised corrugated iron. Some persons may desire to make use of bush saplings so as to have cheaply constructed buildings; this may be done, but it is essential to have an iron roof. It may be thought that as ducks usually camp out in the open it is unnecessary to have an iron roof, but this is absolutely essential for one of the most important factors in the housing of ducks is a dry floor.

Floors.—It is essential for the floor of the house to be dry at all times, a damp or wet floor in a duck house may cause many deaths among the flock, while practically the whole flock will receive a check in growth or production. To ensure dry floors, build up the floor at least 4 inches above the level of the surrounding land; also excavate drains on the highest side of the house, so as to carry away storm water. Concrete floors are best, but an earth floor that has been tamped down fairly hard will be satisfactory. To facilitate cleaning, cover the floor with coarse sand or a litter of hay, grass or straw. The litter will act as a bedding for the ducks. Nests should be provided. These may be placed on the floor against the walls.

BREEDING.

It will be found most profitable to adopt the same breeding season for light-breed ducks as generally adopted for other poultry—namely, June to September. Ducks hatched during these months will commence laying when egg values are high, and continue for about twelve months before moulting. Heavy breeds hatched during June, July and mid-August, will be more profitable, as they can be marketed in prime condition for the Christmas trade. The breeding of heavy breeds may be continued throughout the year, provided that a constant supply of cheap suitable foodstuffs is available.

Selection and mating.—Care must be exercised in the selection of breeding stock. Special attention must be given to type and size. A careful study of the description of the breed is necessary, so as to be able to select birds that are reasonably true to type. Ducks have a tendency to deteriorate very rapidly in size; therefore, it is essential to maintain size of body when selecting breeding birds. In this regard, it is good policy to weigh the birds before placing them in the breeding pen. Defective ducks should not be used for breeding purposes. In mating, the number of females to mate with each male varies with the age of the male, size of run, whether the birds have access to a swimming pool, and the breed. On an average, mate between six and eight females with each light-breed male, and from four to six females with each heavy-breed male. The number of females may be increased if the male is young and very vigorous. Ducks may be safely bred from until they are three or four years old.

MANAGMENT.

Ducks should be kept apart from fowls, as they are greedy feeders and often prevent the fowls from obtaining sufficient food. Their way of feeding is also slightly different. Apart from these factors, ducks make the drinking water unsuitable for poultry. A swimming pool is not a necessity, but where ducks have access to a pool, they keep in better health, their plumage is cleaner, and they are more free from external parasites. In addition, a higher degree of fertility results if breeding birds have access to a swimming pool. As the duck usually lays in the night or early morning, it is necessary to confine them to the run or house until about 9 a.m., otherwise many eggs may be laid in the pool.

Ducks must have a constant supply of clean, cool, fresh water, and when confined during the night water must be supplied. The water vessel should be deep enough for the duck to submerge its head in the water.

Ducks are naturally clean in their habits, but if confined in a small enclosure not properly drained, filthy conditions will result. Therefore, strict sanitation should be practised.

When kept in large numbers, ducks, particularly Indian Runners, are very excitable and easily frightened, and if frightened they are very liable to go into a partial moult.

INCUBATION.

It is the usual practice not to set the first batch of eggs laid by a duck, these being often infertile; also, if fertile, weak ducklings usually result from such eggs.

The period of incubation is 28 days for all breeds with the exception of Muscovy eggs. These take 35 days to hatch. The incubation of duck eggs is best done with ducks. If broody hens are used, it will be necessary to sprinkle the eggs with water regularly. Also sprinkle water on the ground close to the nest, for when the hen comes off she will dust-bath, and her feathers will be moistened when she returns to the nest. The duck, however, will moisten her feathers sufficiently before returning to the nest. With artificial incubation, the temperature should be about 1 degree lower than that for hen eggs—namely 102 degrees. After setting, the eggs should not be disturbed for 48 hours. After this period, they should be turned twice daily, and cooled daily. Each time the eggs are turned, before being returned to the machine, they should be sprinkled with warm water. This sprinkling is essential because the eggs require a lot of moisture. Test, and remove all infertile eggs. Do not open the machine after the ducklings commence chipping until the hatch is complete. Ducklings take longer to break out of the shell than chickens.

REARING.

Ducklings are very hardy, and easy to rear, therefore rearing may be done by artificial methods. Any type of a simple brooder that will permit of water being kept within access of the ducks will prove satisfactory. For instance, a

frame with four legs about 6 inches high to which is tacked a piece of hessian from which flannels hang to within an inch of the ground will give results. First place ample straw on the floor, put down the brooder; the ducklings should be kept under the brooder the first day without food or water. To confine them, use inch netting close up all around the brooder. By adopting this practice they will know where to go when feeling cold. The following night they may be allowed 8 or 10 inches around the brooder, and in this space place water vessels. After about a week, it will not be necessary to confine them to the brooder. After about three weeks the brooder may be removed, providing that ample straw is placed in the shed. One important point must not be overlooked, and that is ground draughts must be prevented. Every day the straw should be forked up and, if necessary, replaced with clean, dry straw. Ducklings must not be crowded; best results will be obtained by rearing ducklings in small units. When about four weeks old they may be placed out in houses for they do not then require much attention apart from plenty of food and water. Ducklings should be protected from the hot sun until they are well feathered on the head and neck; this is more important with Indian Runners than other breeds. Therefore, the rearing pens should have a number of shade trees growing in them; if not, artificial shade should be provided.

FEEDING.

Ducklings require no food for 48 hours after hatching. During this period they could be supplied with water, coarse sand, and charcoal or wood ashes. A mash that will give good results if fed from the first meal until they are about four weeks old is prepared by mixing together pollard, 10 lb.; maize meal, 8 lb.; dried buttermilk, 2 lb.; bonemeal, $\frac{1}{2}$ lb.; and fine salt, 2 oz. If these ingredients are mixed together the amount for each meal may be moistened as required. If available, 3 lb. of curds would replace the dried buttermilk, thus cheapening the ration. Skim milk is excellent for ducklings: it can be used to moisten the mash, but do not give it in the form of a drink. If there is ample milk available, allow it to curd and strain off the whey, then feed the curds. Imitate nature as far as possible by giving several small meals daily to young ducklings. A little and often is a good motto to adopt. After four weeks of age, they may be fed on a similar ration to the mature ducks. When mature it is only necessary to give them three meals daily, supplying as much food as the ducklings can consume in about half an hour. Be sure they have a big evening meal.

A ration that will give excellent results for the feeding of mature ducks is comprised of the following ingredients:—Pollard, 55 lb.; bran, 25 lb.; maize-meal, 10 lb.; meatmeal, 10 lb.; bonemeal, 1 lb.; and fine salt, 1 lb.: to which may be added 25 per cent. of cooked vegetables or chaffed green stuff. The salt should be mixed in the liquid first, so as to ensure a thorough incorporation in the mixture. At least two meals should be given daily, but with mature birds a small meal of whole maize may be fed in addition to the mash.

For the fattening of ducks, consideration must be given to the availability of cheap foodstuffs, which are often obtainable in the form of potatoes, pump-

kins, and other vegetables; these should be boiled and may be added to the mash upwards to 40 per cent. of the bulk. Chaffed green stuff should be included, but do not use much green stuff when making use of a large proportion to other cheap foodstuffs, otherwise the mash may be too bulky.

Always keep a supply of shell grit and coarse sand in receptacles before the birds.

WATER.

Water is one of the biggest factors in successful duck-keeping; they must always have access to ample, clean, cool, fresh drinking water. The water vessel or pool should be sufficiently deep to permit the ducks to submerge their heads. The water vessel should be kept under a shade tree or protected from the sun by providing artificial shade. In rearing ducklings it is a good plan to put a number of stones in the water vessels; this prevents the ducklings swimming and wasting the water.

Water vessels should be constructed so the ducklings can get out easily in the event of their swimming in the vessels, otherwise they may drown through cramp. This cramping is more likely to occur during cold weather.

COMMON TROUBLES.

As stated previously, ducklings are hardy and easily reared, but losses will occur if they are neglected. The most common troubles are chills and staggers.

Chills.—Symptoms—Watery eyes and nostrils. Cause—Wet or damp sleeping quarters.

Remedy—Keeping the floor dry is the most important point. The drinking water may be slightly coloured with permanganate of potash, and changed several times daily.

Staggers.—Symptoms—Ducklings stagger about and fall on their backs before dying. Cause—Lack of water. When water is supplied after there has been a shortage, the ducklings gorge themselves, bringing about this condition.

Remedy—Keep a constant supply of drinking water before the ducklings.

REPORTS.

RECOMMENDATIONS MADE TO DEAL WITH THE QUESTION OF DELIVERY OF IMMATURE CANES BY FARMERS TO FACTORIES.

Serious complaints have been made by certain sugar estates on account of the cutting and sale of immature canes by farmers to factories. As canes are sold by weight and as a minimum price paid to farmers per ton of cane has been fixed, the factories experienced some difficulty in dealing with the problem. The Department's attention was drawn to the situation through a letter from the Sugar Producers' Association. The Department promptly communicated with the District Administration advising that "the village authorities should come to some understanding in regard to maturity, etc." It was at the same time indicated that the age of cane should be made the "starting point" for control on the periods of harvesting of farmers' cane. The village authorities in the districts concerned have been requested by the District Commissioner to keep registers in which will be recorded the names of all cane farmers, the acreage cultivated by each showing the area under plants and ratoons, the date of planting and the approximate date for reaping. To help in this connection, the Department has also recommended the use of hand refractometers by the estates' field staff as a means of assisting to determine rapidly and under field conditions the suitability of cane for reaping. Trials with this method, especially in regard to sampling, are being conducted at the Sugar Experiment Station and a small number of hand refractometers are now on order.

In order to deal comprehensively with the question, a meeting was held on November 19, presided over by Hon. F. J. Seaford, to discuss the problem and to propose methods calculated to ensure the sale of ripe cane. Those present were :—

1. Hon. F. J. Seaford (President, Sugar Producers' Association).
2. Hon. J. S. Dash (Director of Agriculture).
3. Hon. J. I. D'Aguiar (Member of Legislative Council for Central Demerara).
4. Mr. M. B. Laing (District Commissioner, East Demerara).
5. Mr. W. H. Richards (Manager, Pln. Lusignan).
6. Mr. C. H. Palmer (Manager, Ressouvenir Estates, Ltd.),
7. Mr. W. S. Jones

The recommendations proposed are as follows:—

1. The villages to have registers, prepared and kept up to date, of all sugar lands, with dates of planting, reaping, age of cane, etc., and where possible the chart system to be adopted; managers of estates buying farmers' canes to be furnished with a copy of the register.

2. The estates' authorities to help as much as possible, and give instructions where and when cane cutting is to be done; any farmers cutting canes other than those selected by the estate to be liable to have such canes not accepted; this, however, not to relieve cane farmers of the responsibility of producing cane fit for grinding and the estates' authorities to retain the right of rejecting canes found to be unripe or unfit.

3. Manure to be advanced by the estates to farmers at cost and freight plus 10%.

4. As efficient drainage is an important factor affecting maturity of cane, farmers to devote more attention to this cultural measure and a special effort to be made to introduce the block system advocated previously

5. A Committee to be appointed to deal with any disputes or other points that may arise in connection with development and control of cane farming on the East Coast; the Committee to consist of the gentlemen present at the Meeting, also Mr. R. H. Payne, Manager of Pln. Enmore, and two representatives of each of the villages of Beterverwagting and Buxton.

The District Agricultural Committees are also giving attention to this matter.

J. S. D.

SUMMARY OF CROP REPORTS AND DEPARTMENTAL ACTIVITIES, SEPTEMBER—DECEMBER 1934.

Compiled by the Deputy Director.

WEATHER.

The latter part of the year has been rather dry, the rainfall for August and September being below the average for these months. October had rather more rain than usual, but November and December have both been dry and at the time of writing the Christmas rains have hardly materialised.

GENERAL CROP CONDITIONS.

Sugar:—Harvesting operations for the autumn crop on the estates throughout the Colony are nearing completion. Due to the extensive and disastrous floods experienced in December and January last followed by very little rain from January to June, the losses sustained by the industry during the year are estimated at approximately 20,000 tons of sugar.

The following cane experiments have been harvested at the Sugar Experiment Station, Sophia, and on the various Sugar Estates in the Colony:—

28 variety trials ;
4 manurial trials ;
2 fllood-fallowing trials.

P. O. J. 2878 and Diamond 10 continue to outyield the standard cane D625. The former seems to have been specially resistant to flood-damage. D.11/28 has maintained its early promise and has led D.625 in all the trials reaped this half-year. Co.213 has heavily outyielded D.625 as a first ratoon. Several 1930 seedlings have outyielded D.625 in their first plant cane trial. In connection with these trials, 1,401 cane samples have been crushed and analysed.

Five new experiments have been started with the object of comparing the effects of half-ton and one-ton applications of lime and limestone to frontland soils.

Two trials involving a comparison of the effects of sulphate of ammonia and calcium cyanamide on pegassy soil have been initiated, whilst fifteen Latin squares have also been laid out to determine the nitrogen requirements of P.O.J. 2878 and Diamond 10.

A series of weekly growth measurements are being taken on two plant cane and two ratoon fields at Sophia. The fields are receiving different irrigation treatments and the soil moisture content is also being determined weekly. The results will, it is hoped, provide useful data in connection with the response of cane growth to moisture conditions.

A total of 350 boxes has been sown with fluff from 150 crosses. The 1933 seedlings are undergoing their first selection (based on weight of stool, and total solids as determined by the Zeiss refractometer) at the time of writing.

A total of 450 bags containing approximately 58,500 cuttings have been distributed locally. Cuttings of a few varieties have been sent to the Quarantine Station at Trinidad, and twelve bottles of fluff to the Estacion Experimental Agricola de Tucuman, Argentina.

Routine examination of samples of soil from liming trials conducted on various estates were continued. Samples of slaked lime and ground limestone used in the above experiments were also analysed. Canes to be selected for extension at Sophia were examined in the fields by means of a cane sampler and refractometer. Leaves from cane, growing on the various plots in a superphosphate experiment, were examined for nitrogen, phosphate and potash. Samples were taken of several layers of soil which had remained flooded for four months and examined for content of replaceable bases.

Much of the Department's extension activities continue to be devoted to cane-farming and special efforts have been made in the Plaisance area to awaken interest in the industry. In addition to the cuttings distributed to the estates, several farmers have received planting material in an effort to encourage stands of high-yielding varieties in peasant cultivations. Cane farmers have also greatly benefited from the minimum price guaranteed them by the sugar estates for the purchase of their canes. This minimum price, fixed by the Sugar Producers, has further encouraged the farmers to maintain and extend their present cultivations.

The average price per ton for sugar during the past three months has been between $31 and $33 as compared with $40—$43 during the same period for 1933.

An enquiry into the status of the toad *Bupo marinus* L. as a check on certain Dynastid beetles was made. The findings, which are embodied in a report made to the Director of Agricuture show that the amphibian consumes "hard-backs" only in the adult stage and in great moderation and is probably totally unable to feed on the larvae.

Rice.—The Autumn Crop has now been harvested under favourable weather conditions. In spite of the loss of seedlings in the nurseries caused by the drought, more especially in those areas where the crop is entirely dependent on the short growing season that followed, the yields on the whole have been much better than was at first anticipated. The areas most affected by droughty conditions were those situated on the Upper East Coast, Demerara, and the Huist' Dieren District, Essequibo, where approximately 80 per cent. of the crop was lost.

A total of 3,226 bags of padi obtained from the Department's stocks and purchased from Flood Relief Funds was distributed to farmers for the establish-

ment of private seed farms and replacement of seed in areas where unfavourable weather conditions had destroyed previous plantings.

The total acreage planted during the autumn crop in comparison with the same period for 1933 was as follows:—

District	Acreages 1933 Acres	Acreages 1934 Acres
East Demerara	24,800	18,009
West Demerara	7,175	6,129
Essequibo	13,066	9,767
Berbice	27,120	22,338
Total: British Guiana ...	72,161	56,543

The Department's multiplication and demonstration blocks gave the following results:—

Henrietta ...	9 acres	...	190 bags	*Blue Stick*
Sans Souci ...	5 „	...	100 „	„ „
Leguan ...	5 „	...	120 „	*No. 79*
La Jalousie ...	10 „	...	200 „	„ „
Nonpareil ...	5 „	...	155 „	„ „
Port Mourant	15 „	...	420 „	„ „

In addition to the above supplies of seed, funds provided by Government have enabled the Department to purchase approximately 1,400 bags of pure line padi from selected areas for distribution purposes during the next spring and autumn crops. Arising from flood losses a complete re-organisation in regard to the establishment of private pure line seed farms throughout the Colony for future supplies has been effected with the co-operation of the estate proprietors as well as that of the small farmers.

The padi bug made its presence felt more especially in the Berbice District, but ceased to be troublesome towards the end of October. This bug, which has been an intermittent pest of padi in the field during the past decade at least, has been closely studied in the laboratory and the data obtained constitute a paper on the subject, which appears elsewhere in this issue.

Judging of the rice competitions has been completed in the various counties and prizes awarded.

The following results have been obtained from variety padi trials conducted at the Rice Fxperiment Station, Georgetown:—

Variety Trial No. 1: The variety *Blue Stick* headed the list and was significantly better than all varieties except *No. 79*. *No. 79* was significantly better than *Ramcajara*, *Demerara Creole* and *Kalyaman*. *H7* was significantly better than *Demerara Creole* and *Kalyaman*. *Kalyaman* has given significantly

lower yields than all other varieties and will not be included in further trials at the Georgetown Station.

Variety Trial No. 2 :—There were no significant differences between strains of *No. 79*, but they were all definitely superior to *Demerara Creole* in yield. The selected strain of *Demerara Creole* gave 1.8 bags more per acre than the ordinary seed but this difference was not significant.

Variety Trial No. 3 :—There was no significant difference between the two leading varieties, *Lead Rice* and *D.114*, but these two gave a significantly higher yield than all other varieties. There were no significant differences between *McKenzie Small*, *D.111* and *No. 78*, but under the conditions obtaining in this trial, *McKenzie Small* and *D.111* may be said to be better than *No. 75*, *H6* and *No. 79* while *No. 78* was better than *No. 79*. There were no significant differences between the three lowest varieties, namely *No. 75*, *H6* and *No. 79*.

Interesting results have also been obtained with trials in connection with the double transplanting of rice and these are being continued. Details of results of these trials will be found elsewhere in this issue. Eighty varieties are being kept under observation at the Experiment Station Progeny Row Plots for the next Spring crop. The number is made up as follows :—

Origin	Number of Varieties
Imported from other counties during 1934	53
Collected in Berbice and Essequibo	15
Grown on Experiment Station prior 1934	12
Total	80

In addition 22 sixth generation hybrid strains are being compared with standard varieties.

The inheritance of size and shape of grain and other characters are being studied in the F2 progenies of three crosses.

Various methods of control for the Rice Weevil (*Calandra oryzae* L.) by the adulteration of rice have been investigated. Experiments have been laid down on a large scale and examined over a period of several months. It is hoped to publish the results of these experiments in the next issue of the Journal. The enquiry into the variation in the hardness of rice and its behaviour in different circumstances which was begun some time ago was continued during the past quarter and much new information obtained.

The chief features in the new Grading Regulations which came into force on the first of October were that they defined the limits of colour in each grade and they provided that all rice should be shipped in new bags. The first of these provisions is to help the buyer to know more certainly what quality rice he will get in the grade which he wishes to purchase, and it has prevented the exportation

of what may be termed 'bastard grades'. The second provision has met with much approval in the Colony's chief markets and has given buyers a further incentive to purchase the Colony's product.

Owing to the fact that the market for Super rice is a limited one, it has been found necessary to amend the new Grading Regulations by introducing a grade known as No. 1 Extra in order that producers of Super-coloured rice will have a wider margin within which to dispose of their crops.

Exports of rice for the three months ending 30th November compared with the same period last year are as follows :—

1934

	Wohle Grain Super Bags	Super Bags	No. 1 Extra Bags	No. 1 Bags	No. 2 Bags	No. 3 Bags	White A. Bags	White B. Bags	Super Broken Bags	Broken Bags	Total Bags
Sept.	5	299	...	783	431	4,538	1	20	14	150	6,24
Oct.	25	237	812	417	1,925	2,237	...	3	...	9	5,66
Nov.		1,507	1,908	663	3,652	7,146	134	1	...	...	15,01
Tot'l	30	2,043	2,720	1,863	6,008	13,921	135	24	14	159	26,91

1933

	Whole Grain Super Bags	Super Bags	No. 1 Bags	No. 2 Bags	No. 3 Bags	White A Bags	White B Bags	Super Broken Bags	Broken Bags	Total Bags
Sept.	65	3,369	6,944	6,545	10,405	206	32	40	...	27,606
Oct.	...	2,943	6,454	9,672	15,377	230	285	112	55	35,128
Nov.	...	2,086	5,825	6,704	19,837	143	151	20	15	34,781
Total	65	8,398	19,223	22,921	45,619	579	468	172	70	97,515

Quotations for old crop Burma rose to 10/9, or $3.70 per bag of 160 lbs., in August, but fell rapidly to 8/6, or $2.90 per bag of 160 lbs., in November, whilst new crop Burma opened at higher levels than last year, early prices being 8/9 per cwt., or $3 per bag of 160 lbs., compared with 7/9 in the previous year, but has fallen to 7/3, or $2.77 per bag of 160 lbs.—very near the low level reached towards the end of last year.

The prices fixed by the British Guiana Rice Marketing Board for No. 2 Rice to Trinidad were as follows :—

24.8.34—$4.00
12.9.34— 3.80
16.10.34— 3.20
Current prices— 3.20

Better qualities, such as Milled Seta Patna which compares with the Colony's Super Rice, have maintained a better level than the Burma qualities, quotations for the new crop being as set out below, compared with the prices fixed by the Marketing Board for the same period.—

		Milled Seta Patna	*Demerara Super*
16.10.34	...	12/9	18/9
17.11.34	...	—	17/11
23.11.34	...	12/1½	—

Coconuts.—Renewed interest is being shown in coconut cultivation owing to the increased sale of locally manufactured edible oil. Copra producers, however, have been discouraged on account of low prices and in Wakenaam, most of the nuts are being converted into oil and in certain instances, small crushing mills have been erected for oil extraction.

The chief pest of coconuts, *Brassolis sophorae* L., continues to demand attention and in consequence, control measures are being adopted much more generally. The Department's activities with the conservation of parasites have been maintained.

Coffee.—The indications are that the coffee crop will, generally, be a good one, although around Koriabo (North-West District) yields are likely to be poor. The effects of wilt, *Phloem necrosis*, was observed in some instances, and control measures continue. A total of $4,000 has been loaned to Pomeroon farmers to assist them in replanting the coffee areas destroyed by floods. Average coffee prices in Georgetown for the past three months have been from 5½c. to 6c. per lb.

Cacao.—Careful search has been made by the District Officers to discover strains of cacao resistant or immune to Witchbroom disease (*Marasmus perniciosus*). A few trees which had previously shown no signs of disease were found at a recent inspection to be infected. Several new trees have been selected at Middlesex, Coverden and in the Berbice District for further observation.

Bananas.—With regard to bananas, a nursery with some 3,000 suckers of the Gros Michel variety has been started at the Georgetown Experiment Station. Plants from this nursery will be used to start five-acre blocks at an early date. The joint trial at Pln. Dunoon, East Bank, Demerara, with suckers from the Experiment Station are reported to be making good progress.

A small cultivation of Cayenne (Gros Michel) bananas at Pln. Brickerie, East Bank, Demerara, was found to be badly attacked by "Moko" disease. Plantains on the same cultivation were also observed to be infected.

Pineapples.—Special attention has been paid to the pineapple cultivation at the British Guiana Fruit and Canning Company's Concession at Dalgin, Demerara River. Manurial experiments were laid down by the Department. The plants, however, have suffered from the effects of wilt disease and also from attacks of the mealy bug. Ten crowns of a triploid hybrid resulting from a cross between the Smooth Cayenne and Wild Brazil varieties were received from Hawaii.

Papaws.—Detailed observations are being made on the fruit obtained from the "Walcott" and "Panama" papaw varieties. Re-action to cold storage is being investigated.

Onions.—Much interest has been taken by farmers in onion cultivation and assistance wherever possible has been given to ensure proper cultivation and care of seedlings. Sixty pounds of onion seed, obtained from Teneriffe, have been distributed for the autumn planting.

Plantains.—In East Demerara, over 2,000 plantain suckers were distributed to farmers whilst on the Anna Regina estates, planting material obtained by means of Flood Relief funds has been of considerable benefit to farmers in that area.

Ground Provisions.—Good crops of various kinds of ground provisions are now being harvested. Judging of the competitions which were started after the floods to encourage the establishment of private food crops has been completed and prizes awarded.

Citrus.—Much interest is being shown in the extension of citrus cultivation throughout the Colony and efforts are being made to supply applicants with budded plants as quickly as possible. Fruit from budded citrus trees are now ripening in large quantities on the Department's experimental blocks at Hosororo, North West District. Careful notes are being kept of yields, uniformity and quality of fruit; budwood for propagation purposes will be taken only from those trees which are up to standard in respect of these considerations.

School Gardens.—Gardens continue to receive the special attention of the District Agricultural Officers and serve a useful purpose in education and demonstration.

Livestock,—Two young bulls of Holstein-Friesian breed and of good pedigree, have been received by the Department and will be kept for stud purposes. The services of other stud bulls stationed in different areas of the Colony continue to be in demand.

A steady demand for young pigs (of Canadian-Berkshire breed) from the Department's Livestock Farm is still being made by stock-keepers throughout the Colony.

A number of cockerels have been sold and chicks are being raised under "broodies."

Careful trials with forage crops are still being conducted. Seed has been collected from stands of *Andropogon nodosus*, *Phaseolus semi-erectus* and three varieties of Lespedeza. Of these, Lespedeza shows the greatest promise. Grass seed of *Paspalum dilatatum* and *P. virgatum* have grown well. Plots of Para Guatemala and Demerara Primrose grasses have been established.

Co-operative Credit Banks.

The audit of all the Banks has now been completed. Whilst every effort has been made by the Chairman (the District Agricultural Officers, to limit loans for productive work, the non-repayment of overdue loans has given rise to considerable anxiety in many banks.

Beekeeping.

Activities at the Department's Demonstration and Queen-breeding Apiary continue to be largely concerned with the breeding and distribution of pure-bred Italian queens. Two queens were imported from the United States and thus a further supply of new blood brought in. The number of queens distributed for the year is 87 as compared with 52 during 1933. On account of the sustained demand for the Department's queens the number of mating nucleus hives at the Apiary had to be increased from approximately 30 in late 1933 to 60 at the present time.

A revolving fund has been provided for the supply of nucleus hives to beginners or to those desirous of extending their beekeeping activities. Each colony is sold at a moderate price and a number of beekeepers have taken advantage of this facility.

Although scaled hives have been under observation for less than a year, interesting results on the periods of honey flows are indicated. In conjunction with the data on weights of hives, notes in regard to flowering of honey-producing plants are kept.

The Department continues to work in close collaboration with the Beekeepers' Association, and arrangements are now being made to stage a Honey Week early in 1935 to attract public attention to the value of honey as a food and so increase the sale of honey locally.

All of the important honey-producing areas of the Colony were visited by the Department's Beekeeping Officer and useful extension work performed.

THE FIRST MEETING OF THE NEW ADVISORY BOARD OF AGRICULTURE.

PRESENT.

The Director of Agriculture	...	Chairman
The Deputy Director of Agriculture	...	Vice-Chairman
The Hon. R. E. Brassington	...	Members
The Hon. F. J. Seaford	...	Members
The Hon. Peer Bacchus	...	Members
Mr. W. H. Richards	...	Members
Mr. S. Andries	...	Members
with		
Mr. J. F. Irving	...	Secretary

The Chairman said he welcomed the members to the meeting which was the first one to be held under the auspices of the new Advisory Board of Agriculture. He was of the opinion that the Board was a representative one, composed as it was, of gentlemen interested in agriculture in all its various forms.

Excuses were tendered for the absence of Mr. R. B. Hunter and Mr. A. A. Martins.

Discussion on Dwarf Bananas.

The Chairman stated that he was glad that the Board would have a chance that day of meeting Mr. H. Thorndahl, the representative of a Danish shipping company, who was much interested in the shipping of Dwarf bananas to Europe; they would have the opportunity of interviewing him and hearing his views on the subject. It would be important, however, for them to remember that it was necessary for this Colony to have an agent in England for the marketing of the bananas, as the firm was only interested in the actual shipping of the fruit.

Mr. Thorndahl was then introduced to the meeting. He stated that he represented the Danish firm of J. Lauritzen, Steamship owners, of Copenhagen, who had been in existence for over 50 years, and who operated in Europe, Spain and the Baltic. His firm had recently entered the fruit-carrying business in the French West Indies, Brazil, Chili and the Argentine, and he himself had just returned from a trip to Surinam and Cayenne, where he had been to enquire into the possibilities of establishing further business on behalf of his firm. He mentioned that Trinidad was also interested in the matter of shipping Dwarf bananas and he hoped that his firm would be able to make satisfactory arrangements with that island in this connection. It was possible, he suggested, that British Guiana

might co-operate with Trinidad in this respect, and the two Colonies together might be able to supply enough bunches to fill a ship fortnightly. The firm's steamers that were at present engaged in the West Indian trade were of 2,000 tons and capable of carrying 30,000 bunches of bananas, at a speed of 12 knots per hour, but of course, if the question of increased tonnage arose, this could be supplied by them. Freight rates to Europe would be £10 per ton ; a ton of bananas was equal, roughly, to 70 bunches ; the cost per bunch, therefore, working out at about 68 cents. He would be prepared to enter into a contract for the carriage of a minimum of 3,000 bunches fortnightly as from January, 1936.

Mr. Seaford enquired about the manner in which Dwarf bananas were transported and was informed that this variety (which did not suffer from Panama Disease) had to be wrapped before being placed in the holds of the steamers.

The Chairman stated that, although Dwarf bananas grew quite easily in the Colony, the great difficulty at the moment apart from that of marketing was the question of production. At present, there would be difficulty in obtaining satisfactory and sufficient planting material. To obtain the 3,000 bunches of bananas (the minimum quantity) required fortnightly, an area of 250 acres would be required to be planted.

Mr. Seaford stated that it must be realised that it would be difficult to control planting over so large an area, and there was also the question of drainage and excessive rainfall to be considered ; he also enquired what would happen if there should be a large excess of bananas over and above the amount required by the contract for shipment at any given time.

Mr. Thorndahl replied that this was purely a matter of organisation, and that, as his firm would have an agent either here or in Trinidad, such difficulties could be easily overcome. In reply to a further question by Mr. Seaford as to what the estimated loss of bananas would be in transit, Mr. Thorndahl stated that this would be about 10 per cent. on the weight of the fruit—including 3 to 4 per cent. from evaporation. The French islands calculated losses at 7 per cent. but he considered a fair estimate to be 10 per cent.

The Chairman here remarked that one would have to remember the fact that the fruit would be at least three weeks or more in transit, *i.e.*, from the field to the docks.

Mr. Brassington asked what was the acreage under cultivation with bananas in the Colony. The reply was that there was very little, not enough often to supply local demands in Georgetown. Mr. Thorndahl suggested that the Colony introduce banana suckers from Martinique where they were obtainable at 1.25 frs. (8 cents) per sucker, plus freight.

The Chairman said this would have to be carefully considered from the point of view of pests and disease ; the costs also were high.

Mr. Brassington said that too much caution should not be shown and that every effort should be made to obtain a market for the fruit.

Mr. Thorndahl said that he would be glad if he could be informed early next year whether this Colony would be likely to require any tonnage as he anticipated being back in Europe at that time to consider plans. If this Colony did not require the ships, they would likely be put on the Cayenne and Trinidad run; he mentioned that the ships could unload either at Newcastle or at Leith for Edinburgh, and thus tap the north of England and the Scottish markets. He would be prepared to accept other fruit as well and even other cargo if all banana space was not taken in the early stages of development.

After hearing Mr. Thorndahl, who was thanked for his attendance and the information given, the Board decided:

1. That the Director of Agriculture, Trinidad, should be communicated with in regard to co-operating with this Colony in the production, shipping and marketing of Dwarf Bananas; at the same time he should be asked for any available information on such matters as suitable agents in England; prices likely to be obtained; incidental expenses, etc., and the factors in his opinion likely to influence economic returns from the Dwarf banana.

2. That Government be asked to get the opinion of the Agricultural Adviser to the Secretary of State on the possibilities of developing a banana industry with the Dwarf variety; having regard to market conditions in Europe and the factors influencing the success of shipments of that variety; also for any help and advice in regard to making contracts with suitable marketing agents; expenses likely to be incurred, etc.

3. That the Department of Agriculture should secure an early idea of the quantity of planting material likely to be available.

The Chairman said he would give immediate attention to these matters.

ESTIMATES OF DEPARTMENT OF AGRICULTURE, 1935.

The next item considered was the Department's estimates for 1935. The Chairman, handing each member a copy, stated that he would be glad to explain any item not understood by members. Mr. Brassington said it was not clear to him why the services of a Plant Breeder were required. What work did this officer do? This was explained to him at length by the Chairman, and thereafter the meeting terminated.

NEWS.

Plans are now in hand to hold an Agricultural Exhibition in Georgetown in April, 1935, in conjunction with the celebrations in honour of the twenty fifth anniversary of His Majesty's accession to the Throne. The exact date will be announced later and fuller information supplied through the District Agricultural Officers. In the meanwhile, farmers and all those interested are requested to keep the event in mind.

The following is an extract from a letter—dated November 19, 1934—from Mr. Joseph Goodluck of Mahaicony, East Demerara, *re* pure bred mated Italian queens supplied by the Department of Agriculture's Demonstration and Queen-breeding Apiary :—

"I think that you will be pleased to learn the amount of yield obtained
"for the season and it seems to me as though it's not quite done. I have got
"for the crop three drums of honey, roughly about 1,500 pounds. Italian
"queens from your Department have done exceedingly well—could not be
"beaten. Will you please let me know if there are any more queens to be had ?

(Sgd.) JOSEPH GOODLUCK."

The Director of Agriculture has recently been on circuit in East Demerara, West Demerara, Essequibo and Berbice (including the Corentyne).

The Deputy Director's recent tours have included three extended visits to Essequibo. On account of the economic conditions in Essequibo in connection with the reduction of sugar cane acreage and the low prices for rice, agricultural matters have been demanding much thought and attention in the district.

Government has detailed Mr. R. R. Follett-Smith, Chemist-Ecologist, Major T. Bone, Government Veterinary Surgeon, and Mr. A. deK. Frampton, Agricultural Superintendent, Essequibo, to be members of an advance party of a Commission to report on the suitability of certain areas in the Rupununi District for settlement by Assyrians. The League of nations is sponsoring the project and has appointed a Commission consisting of Brigadier General J. C. Browne and Senhor G. R. Giglioli. The Commission arrived in the Colony on October 30, visited the Head Office and Experiment Stations of the Department of Agriculture and were given every access to records, publications, etc.

Mr. A. deK. Frampton (Agricultural Superintendent, Essequibo, from October 1, 1929) has been promoted to the post of Agricultural Officer, Straits Settlements and Federated Malay States. Mr. Frampton is at present in the Rupununi and will leave for his new post soon after his return from the interior.

It was with regret that we learnt of the death of Mr. Maurice Bird on November 10. Mr. Bird was for many years chief chemist of several of the important sugar estates of the Colony and has contributed valuable imformation on different phases of sugar production in British Guiana. His articles have appeared in most of the important sugar journals, both locally and abroad.

The first meeting of the new Advisory Board of Agriculture was held on November 7. Minutes of this meeting are published elsewhere in this issue.

Mr. E. B. Martyn, Botanist and Mycologist and Superintendent of Botanic Gardens, returned from vacation in England on November, 13.

In connection with efforts to produce a variety of lime possessing the good qualities of the West Indian lime combined with resistance to withertip disease, it is significant that under present conditions the growing of Woglum and Philippine limes in withertip areas is found to be unprofitable because of the low price for juice and because essential oils obtained from these two varieties are reported to be definitely inferior to the oil of the West Indian lime.—1933 *Report of the Dominica Department of Agriculture.*

In the 1933 Administration Report of the Director of Agriculture, Trinidad, it is mentioned that budwood was shipped to Nigeria *via* London in thermos flasks in a cool room and "that the method of despatching budwood over long distances in thermos flasks appears practicable"

"A recent introduction of *Guiana Creole* rice from Nigeria has proved so successful that many demands have been made for more seed. This is being done."—*Gambia Department of Agriculture Report*, 1st April, 1933, 31st May, 1934.

Simple Recipes Worth Trying.

(1) Rice and Red Beans.

1 cup rice
1 lb. red beans, soaked overnight.
½ lb. salt meat, cut in strips, one for each serving.
1 onion (leave whole so that it can be removed after cooking if preferred).
Season to taste.

Cook beans, salt meat, onion and seasoning together with enough water to cover well until beans are cooked. Add enough water from time to time so that there will be plenty of thick, rich gravy. Serve with cooked rice.

Note:—1 can red beans may be used in place of the cooked, dried beans Yield: 6 servings—1 cup.

(2) Honey Tea Cakes

1 cup Honey
1 cup sugar
4 ounces shortening
2 eggs
1½ cups milk
4 cups flour
4 teaspoonsful baking powder
Pinch salt
1 teaspoonful vanilla.

Mix sugar, honey, shortening and well beaten eggs. Add milk, then flour in which baking powder has been sifted. Pour in well greased muffin tins and bake 40 minutes. Ice with honey fudge icing. Chopped nuts, cherries, honied grape fruit or orange strips can be sprinkled over tea cake top to lend variety. The honey fudge icing may be made as follows:

1 teaspoonful salt
3 cups powdered sugar sifted with 5 level tablespoonsful cocoa
1 tablespoonful melted butter mixed with 3 tablespoonsful honey
3 tablespoonsful whipped cream
6 tablespoonsful cream or milk.

Sift dry ingredients together, add butter and honey mixed. Stir in whipped cream, then the milk or cream. Stir vigorously until a light and fluffy mixture results.

This is sufficient icing for two honey fudge cakes (consisting of two layers each).

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the Agricultural and Forest Products of the Colony exported for the first first nine months during 1934.

The corresponding figures for the same period during the two previous years and the average for the sixteen years prior to that are added for convenience of comparison.

Product		*Average 1916-31*	*1932*	*1933*	*1934*
Sugar	tons	59,567	73,422	78,942	93,595
Rum	proof gallons	910,210	442,722	533,957	836,496
Molasses	gallons	2,381,579	4,339,750	5,810,744	4,035,920
Molascuit	tons	586	nil	77	nil
Rice	tons	12,307	20,521	22,387	11,697
Coconuts	No.	771	750,358	805,468	1,591,259
Coconut Oil	gallons	15,602	13,604	11,508	9,669
Copra	cwts.	32,148	6,804	18,420	12,000
Coffee	cwts.	4,755	7,421	8,761	4,687
Lime Juice Concentrated	gallons	7,772	958	nil	2,165
Essential Oil of Limes	gallons	437	558	918	392
Rubber	cwts.	52	nil	nil	nil
Balata	cwts.	3,143	3,519	3,881	1,089
Gums	lbs.	682	1,382	nil	nil
Firewood—Wallaba, etc.	tons	7,474	9,699	10,458	10,984
Charcoal	bags	38,786	54,870	45,657	46,355
Railway sleepers	No.	7,251	5,370	7,295	15,583
Shingles	No.	1,298	951,500	731,450	500,700
Lumber	ft.	130,386	107,421	128,941	60,697
Timber	cu. ft.	161,912	118,299	155,830	120,788
Cattle	head	552	447	361	550
Hides	No.	4,662	2,914	3,389	4,820
Pigs	No.	385	326	250	631
Sheep	No.	10	23	nil	nil

CURRENT PRICES OF COLONIAL PRODUCE.

From The Commercial Review, Journal of the Georgetown Chamber of Commerce, Vol. XVIII, No. 5, Friday, November 30th, 1934.

SUGAR.

Per 100 lbs. net 3 lbs. per Bag allowed for tare

Dark Crystals for Local Consumption..........$3.30
Yellow Crystals do. do. $4.00
White Crystals..........$4.75
Molasses Sugar..........none offering

RUM.

Imperial Gallon. Cask included.

Coloured, in Puncheons—40 to 42 O.P...(for export)...50c.; Hhds. 76c., Barrels 77c.
White, in Hogsheads—10 to 45 O.P...(for local consumption)..........45 to 55c.

MOLASSES.

Per Imperial Gallon. Naked.

Yellow (firsts)..........10c.
Yellow (seconds)..........$5\frac{1}{2}$c.
Dark..........$2\frac{1}{2}$c.

RICE.

Rice..........per Bag of 180 lbs. gross : Brown Super $4.00—$4.25 ; No. 1, $3.25—$3.75 ; White $3.00—$3.50 as to quality. Lower Grades $2.75—$3.00 as to quality.

Paddy..........per Bag of 143 lbs. gross: $1.00 to $1.20 as to quality.

GENERAL.

Gold, Raw, ...average per oz. $26 to $28.
Diamonds,—pro rata as to quality..........average per carat $10 to $11.
Timber, Greenheart, (Lower grade measurements)...40c. to 60c. per c. ft; for export 72c. to $1.00 per c. ft.
do. Railroad Sleepers—(Mora)..........$1.68 each.
Greenheart Lumber..........$60 to $70 per 1,000 feet.
Crabwood Lumber..........$60 to $75 per 1,000 feet.
Shingles, Wallaba, 4 x 20 and 5 x 22 inches,..........$3.50 to $5.50 per M.
Charcoal, Capped for shipment..........72c. to 85c. per bag.
Firewood..........$2.16 to $2.50 per ton.
Coconuts...Selects : $9.00, culls...$6.00 M.....Copra $1.00 per 100 lbs. Prime Copra.
Balata..........Venezuelan, none. Local Sheet...36c. to 38c. per lb.
Cocoa..........14c. to 16c. „ „
Coffee..........$5\frac{1}{2}$c. to 6c. „ „

N.B.—Duty on Payable value at time of Importation and rate of exchange on day of arrival.

METEOROLOGICAL DATA—JULY—SEPTEMBER, 1934.

Recording Stations & Months.	Rainfall.	NUMBER OF DAYS OF RAIN						Evaporation	Air Temperature and Humidity.			
	Total Inches.	Under ·10 Inch	·10 to ·50 Inch	·50 to 1·00 Inch	1·00 Inch to 2·00 Inches	Above 2·00 Inches	Total days.	Inches	Maximum.	Minimum.	Mean.	Humidity Mean.
Botanic Gardens.												
July ...	9·81	7	15	1	2	1	26	4·37	85·0	75·5	80·2	83·6
August ...	4.19	6	5	3	1	...	15	5·30	86·6	76·1	81·3	81·3
September ...	1·31	3	4	1	...	...	8	5·90	87.7	76·8	82·2	78·4
Totals	15·31	16	24	5	3	1	49	15·57				
Means.	...	...	...	...	...	...	...	...	86·4	76·1	81·2	81·1
Berbice Gardens.												
July ...	17·89	...	15	2	4	2	23	...	86·4	74·6	80·5	79·0
August ...	9·63	...	9	...	1	2	12	...	87·6	75·0	81·3	79·0
September ...	2·57	...	5	2	...	...	7	...	86·9	74·2	80·6	81·2
Totals	30·09	...	29	4	5	4	42	...				
Means.	...	...	...	...	...	...	...	...	8·69	74·6	80·8	79·7
Onderneeming												
July ...	15·01	...	15	8	5	...	28	...	88·8	73·0	80·9	88·4
August ...	4·25	1	9	1	1	...	12	...	89·1	73·4	81·2	87·8
September ...	3·90	...	4	1	2	...	7	...	89·3	73·6	81·4	87·7
Totals	23·16	1	28	10	8	...	47	...				
Means.	...	...	...	...	...	...	...	...	89·1	73·3	81·2	87·9
Hosororo, North West District												
July ...	8·73	5	15	3	2	...	25	...	89·4	70.8	80·1	83·5
August ...	8·89	6	6	5	3	...	20	...	90·1	70·3	80·2	84·2
September ...	8·00	6	9	4	2	...	21	...	90·5	70·3	80·4	85·4
Totals	25·62	17	30	12	7	...	66	...	...	...	...	...
Means.	...	...	...	...	...	...	...	...	90·0	70·5	80.2	84.4

INDEX TO VOL. V

1934

A

B

C

D

E

F

G

H

Page

I

J

K

L

M

R

T

U

V

W

Y

THE AGRICULTURAL JOURNAL OF BRITISH GUIANA

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CONTENTS.

(VOL. VI, NO. 1.)

LIST OF ILLUSTRATIONS.

WELCOME.

The Agricultural Journal, on behalf of the agriculturists of the Colony, desires to extend a very warm welcome to His Excellency Mr. G. A. S. Northcote, C.M.G., and Mrs. Northcote, on their arrival in this Colony. His Excellency in his first public appearance has asked for the co-operation of the Country. The agricultural section of the community take this opportunity to thank His Excellency for his invitation and pledge their loyal support.

The

Agricultural Journal of British Guiana.

March, 1935.

EDITORIAL.

AGRICULTURAL EXHIBITIONS.

Agricultural, industrial and other exhibitions seem such a typical feature of twentieth century enterprise, that one is unwittingly disposed to associate the idea with the other characteristics of our modern development. It is perhaps names such as the *Wembley Exhibition*, the *Chicago World's Fair*, the *British Industrial Fair*, which help to confirm the impression. But the need of exhibitions and the value served by them have been appreciated for a longer time than that. The first exhibition of which mention is made in history is referred to in the book of Esther, where one King Ahasuerus showed in the third year of his reign " the riches of his glorious kingdom and the honour of his excellent Majesty, many days." The history of the evolution of exhibitions makes interesting reading, but there is only one incident to which it is intended here to call attention. In 1797 and later in 1801 two exhibitions were held in Paris. Napoleon was first consul and in a report to him by a jury of practical men the following remarkable sentence appeared—"There is not an artist or inventor who, once obtaining thus a public recognition.........has not found his business largely increased."

The history of exhibitions in British Guiana also provides interesting, if at times disappointing, reading. The need for shows to help demonstrate to ourselves and others the quality of our products has long been felt and to this *Timehri* bears testimony. Contemporary publications show that many exhibitions were held, some with deserving success, but the organising work was not easy. In the report (*Timehri* Vol. III, 1889) of the *Royal Agricultural and Commercial Society* for 1889 it is stated : "The Government had granted the Society a sum of $1,000 for the purpose of holding a Country Exhibition, and owing to the carelessness and opposition of the people for whose benefit the project had been attempted, the matter had been abandoned."

In later years agricultural associations became responsible for the organising of district shows, the last of which was held at Buxton in 1932. In 1931, in connection with the Centenary celebrations—a representative collection of local agricultural products was arranged and exhibited by the Department and was encouragingly successful. In 1930, 1932 and 1933 combined Agricultural and Industrial Exhibitions were held by the British Guiana Workers' League and the enterprise of this private Body is to be commended. A Committee, with the Director of Agriculture as Chairman, was appointed by Government to draw up details to organise a Colonial Agricultural and Industrial Exhibition in 1933. Plans were practically completed when a series of untoward incidents culminating in the 1933-34 floods compelled an indefinite postponement. In this country which does not possess what may be termed "Exhibition Tradition" it is not easy to have agricultural shows run along the right lines at the outset save the organising body have adequate financial control and enough support of the community to ensure that the right type of exhibits are submitted and that only *bona fide* agriculturists are exhibitors.

On April 25 and 26 next it is planned to stage the *Jubilee Agricultural Exhibition.* The Department of Agriculture, with the co-operation of the Board of Agriculture, is responsible for the organisation of the show. Catalogues giving full details of the classes of exhibits for which entries are invited, the rules of the Exhibition, the prizes to be awarded and other miscellaneous information have been printed and distributed. The Editors of the several newspapers have kindly provided space and advantage has been taken of this co-operation to publish information regularly in order to awaken and maintain public interest in the Exhibition.

As the funds available for this project are definitely limited, the Department made an appeal for the award of cash or special prizes. The response made is greatly appreciated but is not as general as might have been hoped. Donations have already been received and acknowledged in the press from the B.G. Sugar Producers' Association, B.G. Rice Marketing Board, Demerara Tobacco Co., and Messrs. Brodie and Rainer Ltd., and cups from Barclays Bank (Dominion Colonial & Overseas) and the Royal Bank of Canada. It is hoped that firms or individuals who wish to encourage competition among the agricultural producers of the Colony will take advantage of the opportunity now provided.

One of the main difficulties to be overcome in organising an exhibition in a Colony of this size is that of transport. It is neither easy nor cheap for agriculturists in one section of the country to place exhibits in satisfactory condition at shows whose *locale* happens to be in another district. It is therefore satisfactory to be able to report that the Directors of the Transport & Harbours Department have been good enough to offer free transport of exhibits on all routes. It is also gratifying to report that Village and Agricultural Associations, the District

Administration services and rural organisations generally, are giving vigorous and encouraging co-operation in the preliminary preparations. Reports from the districts on the probable entries in the several classes of exhibits indicate that the Show promises to be a successful and well supported event.

The object of an agricultural show may be presumed to be "the improvement of agricultural produce by encouraging competition, by indicating correct standards of excellence, by means of the award of prizes, and by demonstrating the possibilities of improved agriculture." With the aid of our agriculturists, the *Jubilee Agricultural Exhibition*, which we hope is the first of a regular series, will perform these services.

ORIGINAL ARTICLES.

RICE WEEVIL CONTROL.

BY

F. A. SQUIRE, B.Sc., A.I.C.T.A.,

Snpernumerary Entomologist, British Guiana.

(1) By Means of Calcium Carbonate.

For some years the California rice millers have coated their rice with calcium carbonate in order to enhance its appearance. It was generally observed that rice so treated was much less subject to weevil attack than the ordinary product. The question was taken up by the Commercial Minerals Company of San Francisco who engaged Dr. E. R. deOng, Consulting Entomologist, San Francisco, to carry out experiments on scientific lines. This was done on a small scale and results shewed that the calcium carbonate treatment is beneficial.

As local conditions are very different from those obtaining in California it was deemed necessary to carry out an independent investigation of this control measure here. Moreover previous experiments conducted by the Department of Agriculture in British Guiana shewed clearly that many control measures which achieve 100% control on a small scale in the laboratory are useless when applied on a commercial scale. Naphthalene is an example. This substance will preserve rice in jars and paper bags for a long time, but when mixed up with rice in grain bags, it has no deterrent action on the weevil.

For these reasons an experiment was laid down on the 11th of September, 1934. Sixteen bags of No. 3 parboiled rice of 90 lbs were used. Eight were treated and the remainder left as controls. The bags were stacked in alternate piles of four bags, the bottom bag resting on wooden runners. The stacks were one foot apart. The dosage was ½lb. of calcium carbonate per bag of 90 lbs. The bags were weighed before stacking. At this stage the rice was uninfested. The powder was stirred into the rice; and the control bags were given the same amount of stirring as was required, in the case of the treated lot to effect a thorough mixture.

On the 5th December the bags were examined. Separate samples were taken from four sides of each bag and made into a composite sample. From these samples weevil counts were made and the percentage of infested grains estimated. The bags were also weighed. Thus a three-fold estimate of the weevil infestation was obtained. On the 5th February this was repeated. The results obtained are summed up in the following tables :—

TABLE I.

Number of Weevils by 5th December.

Treated.					Untreated				
No. of Bag	Position of Bag	Weevils alive	Weevils dead	Total No. of Weevils	No. of Bag	Position of Bag	Weevils alive	Weevils dead	Total Weevils
2	top	4	2	6	1	top	52	3	55
4	2nd	5	0	5	3	2nd	58	11	69
6	3rd	3	3	6	5	3rd	61	9	70
8	bottom	4	0	4	7	bottom	96	7	103
10	bottom	20	4	24	9	top	38	3	41
12	2nd	0	1	1	11	2nd	37	1	38
14	3rd	1	1	2	13	3rd	57	5	62
16	top	0	1	1	15	bottom	86	12	98
		37	12	49			485	51	536

TABLE II.

Number of Weevils by 5th February.

Treated					Untreated				
No. of Bag	Position of Bag	Weevils alive	Weevils dead	Total Weevils	No. of Bag	Position of Bag	Weevils alive	Weevils dead	Total Weevils
2	top	2	5	7	1	top	236	55	291
4	2nd	8	12	20	3	2nd	213	51	264
6	3rd	3	5	8	5	3rd	171	41	212
8	bottom	12	36	48	7	bottom	254	82	336
10	bottom	41	41	82	9	bottom	218	70	288
12	3rd	11	7	18	11	2nd	183	54	237
14	2nd	18	23	41	13	3rd	218	42	260
16	top	1	7	8	15	top	114	25	139
		96	136	232			1,607	420	2,027

TABLE III

Loss in Weight.

Treated				Untreated			
No. of bag	Loss in wt. by 5th Dec.	Loss in wt. by 5th Feb.	Position of bag	No. of bag	Loss in wt. by 5th Dec.	Loss in wt. by 5th Feb.	Position of bag
2	0 lbs. 8 ozs.	0 lbs. 8 ozs.	top	1	2 lbs. 0 ozs.	6 lbs. 12 ozs.	
4	0 „ 8 „	0 „ 8 „	2nd	3	1 „ 8 „	5 „ 12 „	
6	0 „ 8 „	2 „ 8 „	3rd	5	1 „ 8 „	5 „ 8 „	
8	1 „ 8 „	2 „ 0 „	bottom	7	3 „ 0 „	8 „ 0 „	bottom
10	1 „ 8 „	3 „ 8 „	bottom	9	4 „ 8 „	9 „ 12 „	bottom
12	1 „ 0 „	1 „ 0 „	2nd	11	2 „ 0 „	5 „ 0 „	
14	0 „ 8 „	2 „ 0 „	3rd	13	2 „ 0 „	6 „ 8 „	
16	1 „ 0 „	1 „ 0 „	top	15	1 „ 8 „	5 „ 8 „	
	7 lbs.	13 lbs. 0 oz.			18 lbs.	52 lbs. 12 ozs.	

TABLE IV

Infestation of grains by 5th December.

Treated					Untreated				
No. of Sample	No. of grains	No. of infested grains	Per cent. Infestation	Average % Infestation	No. of Sample	No. of grains	No. of infested grains	Per cent. Infestation	Average % Infestation
1	614	4	0.65		1	585	59	10.08	
2	633	3	0.47	0.49	2	580	59	10.17	11.54
3	592	2	0.34		3	550	79	14.37	

TABLE V

Infestation of Grains by 5th February.

Treated				Untreated			
No. of Sample	No. of Grains	No. of infested grains	Per cent. Infestation	No. of Sample	No. of grains	No. of infested grains	Per cent. Infestation
1	637	29	4.5	1	648	135	20.8

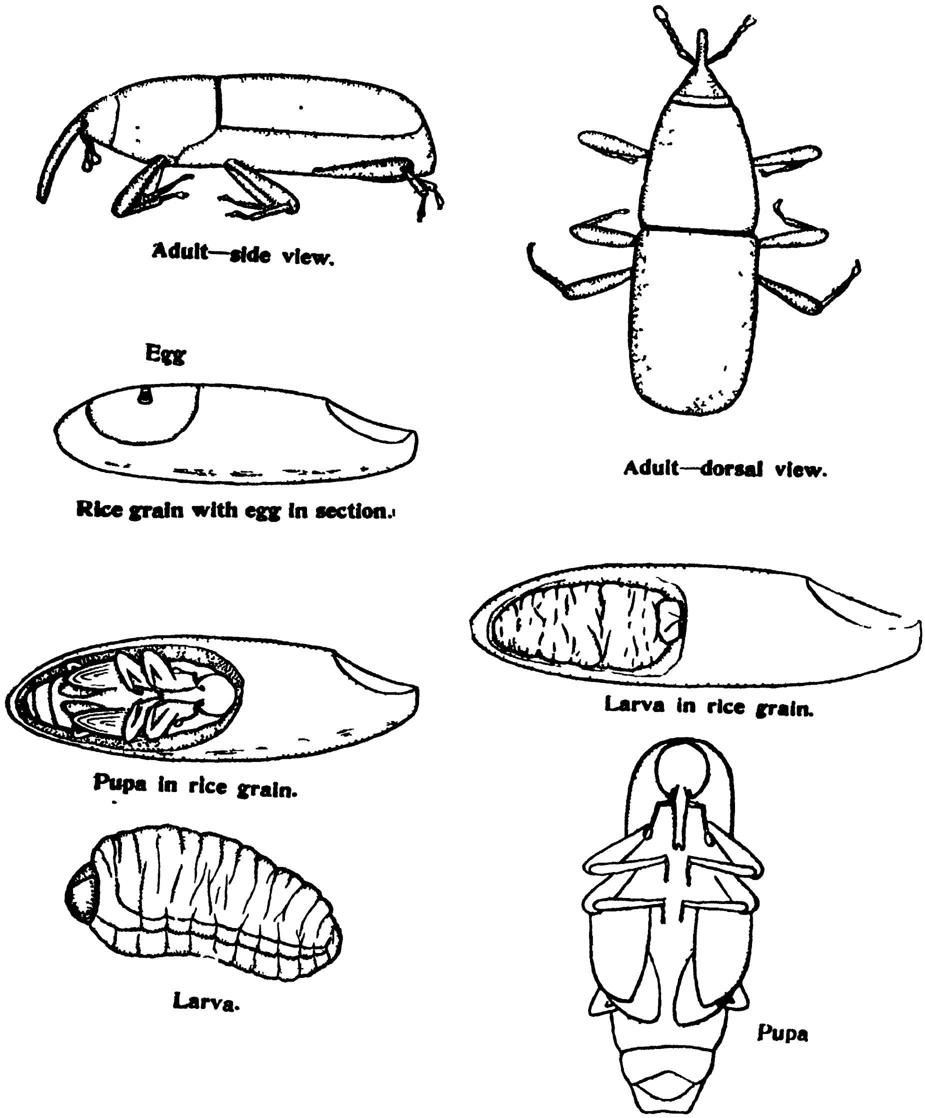


Fig. 1. Stages in the life history of the rice-weevil, *Calandra oryzae*, Linn.

TABLE VII.

Treated				Untreated			
No. of Bags	Dead Weevils	Live Weevils	Total	No. of Bags	Dead Weevils	Live Weevils	Total
1	7	18	25	15	63	171	234
2	0	0	0	16	57	314	371
3	2	1	3	17	37	209	246
4	2	1	3	18	33	137	170
5	0	0	0	19	20	129	149
6	24	38	62	20	18	162	180
7	12	32	44	21	22	164	186
8	20	31	51	22	21	157	178
9	4	1	5	23	11	79	90
10	4	0	4	24	10	91	101
11	27	41	68	25	22	225	247
12	6	11	17	26	38	200	238
13	4	0	4	27	40	196	236
14	5	1	6	28	51	112	163
Grand Total			292	Grand Total			2,789
Per cent. dead			40.06	Per cent. dead			15.9

The samples from each lot were then lumped into a single sample representing treated rice in one case and untreated in the other. The samples were well mixed and counts of infested grains made from sub-samples. The results are given in Table VIII :—

TABLE VIII.

Treated				Untreated			
No. of Sub-sample	No. of grains in sub-sample	No. of infested grains	Per cent. of grains infested	No. of sub-sample	No. of grains in sub-sample	No. of infested grains	Per cent. of grains infested
1	653	20	3.1	1	562	87	15.5
2	647	16	2.5	2	572	110	19.2
3	670	14	2.1	3	528	92	17.4
Mean			2.6	Mean			17.3

Finally, to confirm the results already obtained, the bags were weighed and the loss in weight since the beginning of the experiment calculated. The results are given in the following table.

TABLE IX.

Treated			Untreated		
No. of Bag	Loss in weight		No. of Bag	Loss in weight	
1		2 ozs.	15	7 lbs.	2 ozs.
2		2 ,,	16	4 ,,	10 ,,
3		0 ,,	17	4 ,,	10 ,,
4		0 ,,	18	6 ,,	10 ,,
5		0 ,,	19	3 ,,	10 ,,
6		2 ,,	20	3 ,,	2 ,,
7		0 ,,	21	2 ,,	10 ,,
8		0 ,,	22	4 ,,	2 ,,
9		0 ,,	23	4 ,,	2 ,,
10		2 ,,	24	3 ,,	2 ,,
11		10 ,,	25	5 ,,	2 ,,
12		10 ,,	26	4 ,,	2 ,,
13	1 lb.	2 ,,	27	5 ,,	2 ,,
14		10 ,,	28	5 ,,	10 ,,
Total loss	3 lbs.	8 ozs.	Total loss	63 ,,	12 ,,

From the foregoing it will be seen that a considerable loss of rice may be prevented by using the sodium fluorsilicate treatment. Its effectiveness is perhaps best brought home to the merchant by Table IX. Here it will be seen there is a total loss of roughly 63 lbs. on 14 bags of 90 lbs. each, *i.e.*, a 5 per cent. loss. And this loss took place during 4 dry months, viz:—July to October. The saving due to the treatment was 4.8 per cent.

Judging by the results of previous experiments, it is no exaggeration to say that the loss would have been greater had it been calculated over a rainy period. Furthermore in considering the damage done by the weevils it must be remembered that the weevils, and consequently the loss, increases in geometrical progression as will be seen from the control half of Table X summarising the loss in weight.

TABLE X.

Average loss in weight per bag.

Date	Treated	Untreated
June 25	Experiment started	
Sept. 10	2.24 ozs.	12 ozs.
Oct. 25	3.1 ,,	73 ,,

The control shews a sixfold increase in loss during the latter $1\frac{1}{2}$ months. At this rate of progression a total loss theoretically would result in less than 6 months. In practice of course the weevils stop breeding in the rice when the infestation approaches the 100 per cent. mark. In the case of the treated lot it will be seen, there has actually been a decrease in the rate of destruction during the latter $1\frac{1}{2}$ months.

These results are set out in Fig. 3.

Economics of the Treatment.

Sodium fluorsilicate can be landed in Georgetown at 10 cents per lb. The cost of lime is 75 cents per 100 lbs. so that the cost of the treatment per bag works out at $1\frac{3}{4}$ cents. The labour employed need not be reckoned as the admixing of the insecticide can be carried out during the process of blending.

Comparing the Two Treatments.

Calcium Carbonate.

Percentage saving based on loss in weight over 6 months was 5.6 per cent. Cost of treating a bag of 90 lbs was $2\frac{1}{2}$ cents.

Sodium fluorsilicate

Percentage saving based on loss in weight over 4 months was 4.8 per cent. Cost of treating a bag of 90 lbs was $1\frac{3}{4}$ cents.

It will be seen that there is little difference between the treatments on the score of cost and effectiveness and considering the prejudice against the use of sodium fluorsilicate, the calcium carbonate treatment is recommended in preference to the other. Calcium carbonate so far from being harmful is actually beneficial in small quantities in certain circumstances. Moreover it enhances the appearance of the rice when mixed with it.

These control measures are not only far less costly than fumigation but they are also safe and easily put into effect. This cannot be said for weevil control with carbon bisulphide. Effective fumigation as shewn in (1) is an impossibility under local conditions.

(1) *Rice Bull. No. 1*, pt. IV., Dept. Agric. British Guiana.

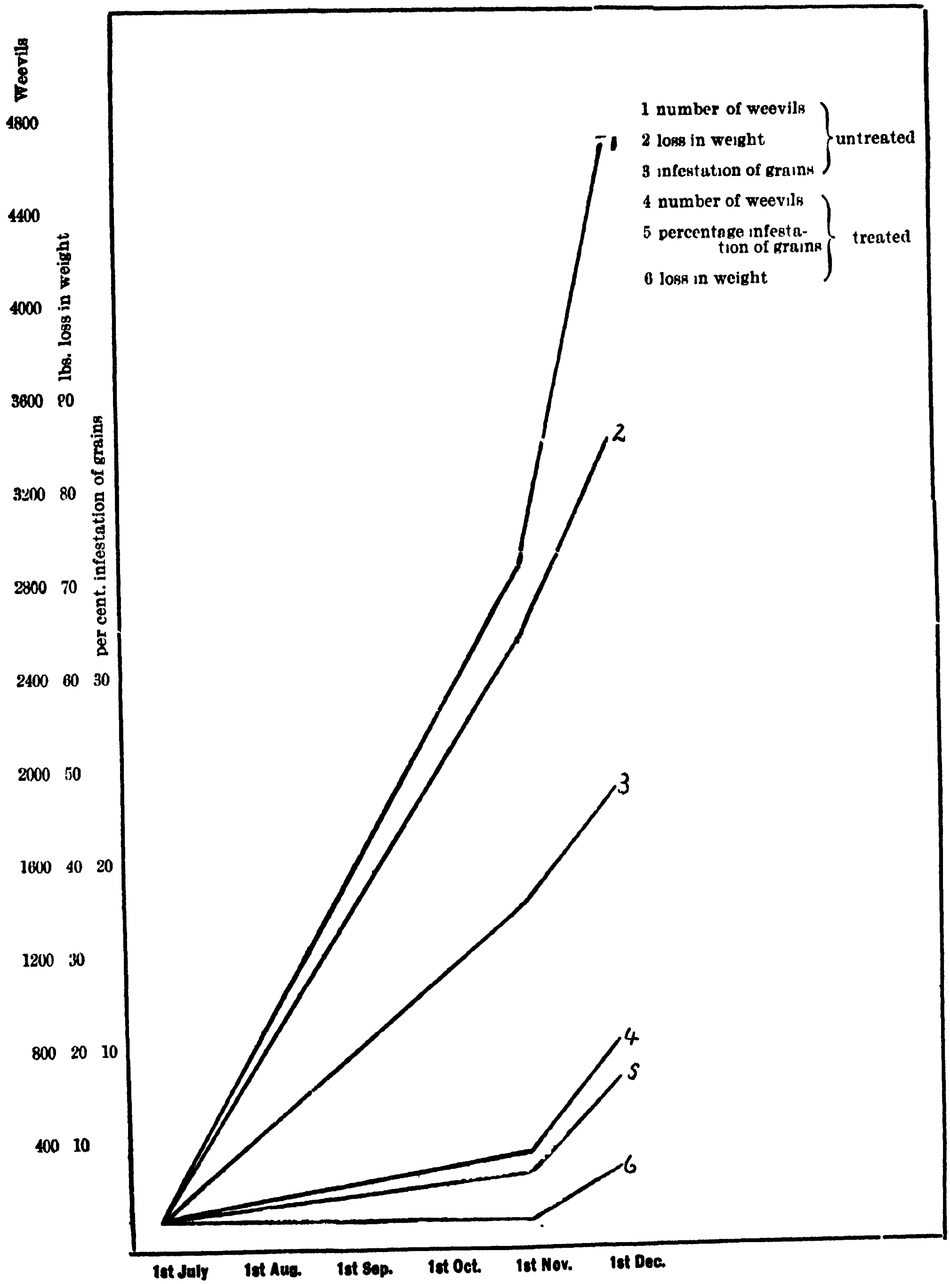


Fig. 3. Graph shewing the effect of the sodium fluorsilicate treatment on rice weevil infestation.

PLATE IV.

Average Monthly Rainfall of Coastland Stations, British Guiana, 1890—1933.

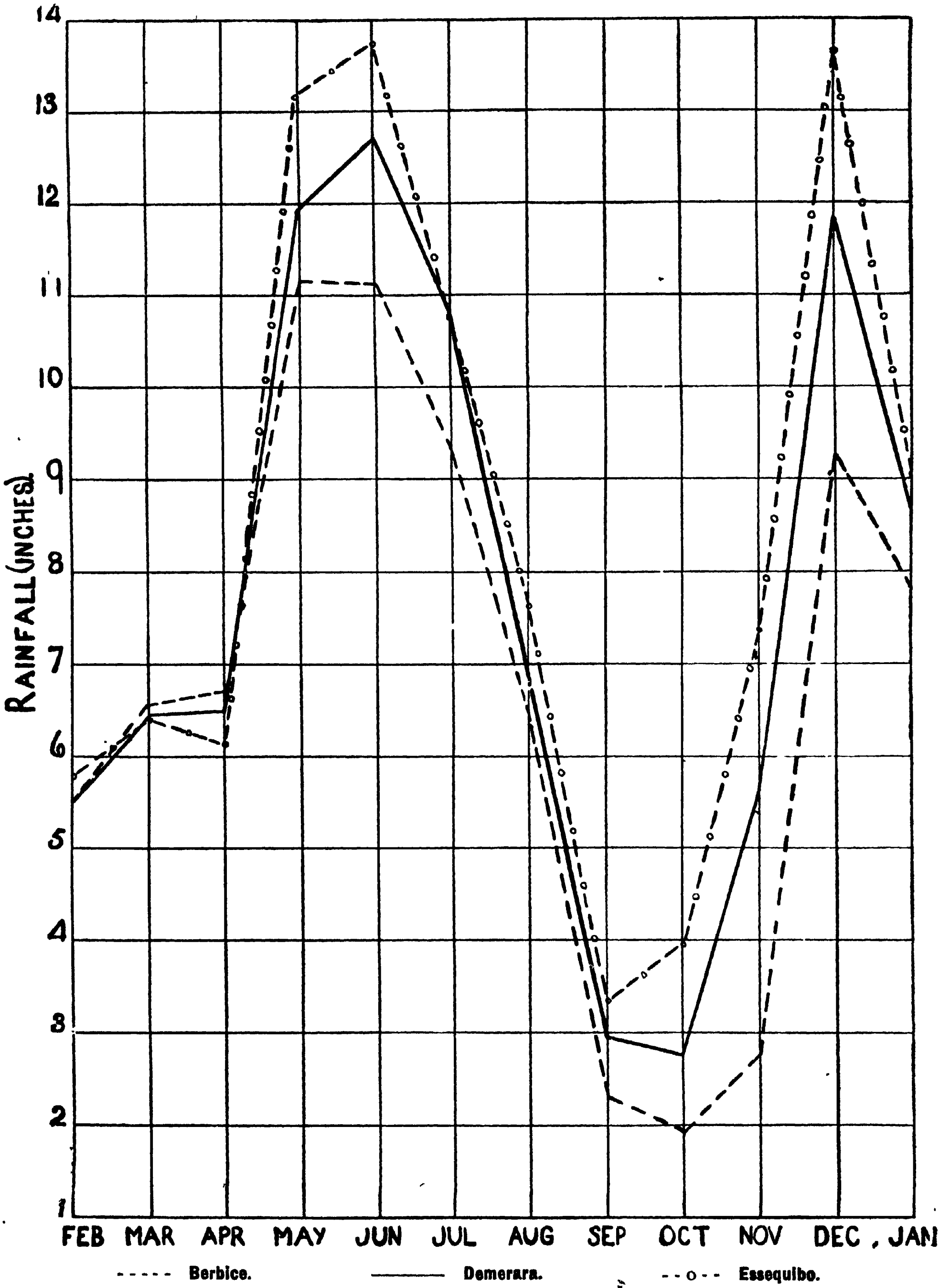


Fig. 1. May to August and mid-November to January are months of highest rainfall. February to April and September to mid-November are months of lowest rainfall.

PRICES AND SHIPMENTS OF AGRICULTURAL PRODUCTS IN BRITISH GUIANA.

BY

H. D. HUGGINS, M.Sc., Dip. Agr.

INTRODUCTION.

The writer has previously* computed indexes of the average yearly prices of the important agricultural products of British Guiana and of the chief articles entering into the local cost of living; these index numbers rendered it easy for one to compare each product considered with itself, or with any or all other products studied, in regard to yearly price changes. A logical corollary to this work appeared to be the determination of price changes within the year, that is, from month to month or from season to season. For example, although it may be known that the average c.i.f. London price of sugar in 1933 was $2.42 per cwt. it may, for certain purposes, be desirable also to ascertain whether the tendency has been for prices of sugar in January to be as high as in, say, July. Periods of crop production are largely controlled by weather conditions. Weather conditions in some months of the year are not the same as in other months of the year and, in consequence, the supplies of agricultural products vary from month to month. As supply and price are intimately related there is a tendency, in the case of some products, for a definite relationship to exist between price fluctuations and the seasons of the year. Another factor contributing to this seasonal variation in prices is that the demand for some products (*e.g.*, coffee) varies, being high at some, and comparatively low at other, seasons.

A description is given of the results obtained in an effort to determine the seasonal changes in the ruling prices of the important agricultural products of British Guiana. The monthly prices of sugar (raw crystals), rum, padi, rice, coconuts, coconut oil, copra and coffee have been examined. In the case of those products whose export trade is of importance, the seasonal variation in shipments is discussed in conjunction with the seasonal variation in prices.

The period, for which British Guiana price data are available, is comparatively short. The price quotations, except in the case of sugar, have been extracted from the *Commercial Review*, the official publication of the Georgetown Chamber of Commerce; the sugar quotations (c.i.f. preferential, 96° polarisation) have been obtained from the *West India Committee Circular*. The figures for monthly exports have appeared in statements supplied by the Customs Department but published in the *Commercial Review*.

The method of calculation employed was that commonly adopted for determining the seasonal variation in prices. The quotations for each product for each month for each year were tabulated and monthly and yearly averages

*Agr. Jour. of British Guiana, Vol. V. No. 2 pp. 101-112.

found. The equation of secular trend was obtained and trend eliminated (the correction used being in terms of monthly intervals). The corrected price for each month was then expressed as a percentage of the average monthly price. This percentage figure is usually termed the index of seasonal variation.

THE SEASONS IN BRITISH GUIANA.

The prices under consideration are all either controlled or significantly affected by conditions ruling in markets abroad so that while local seasonal conditions affect the periods at which the several crops are produced, seasonal variation in prices is not entirely to be explained by seasonal conditions in British Guiana. In other words, although the local rainfall and other weather conditions may have little effect on the f.o.b. price of coffee, or c.i.f. price of sugar, it is the local rainfall distribution which mainly determines the periods at which sugar estates grind and the coffee growers harvest. In arriving at conclusions, based on a study of the fluctuations in prices and exports, it will, therefore, be helpful to have a clear conception of exactly how the months of the year are grouped to form the seasons in British Guiana.

Rainfall is the factor of primary importance in making a distinction between the seasons in this country. In Fig. 1 the average monthly rainfall of coastland stations in Demerara, Berbice and Essequibo for the period 1890-1933 is plotted.† The average annual precipitation is 91.42 inches and is therefore comparatively high; the average rainfall in no month is less than approximately 2 inches. There are two 'wet seasons' extending, in one case, from May to August and, in the other, from the middle of November to January; there are also two 'dry seasons' extending from February to April and from September to mid-November.

SUGAR.

TRADE.

Most of the sugar exported from British Guiana is raw sugar polarising about 96°, and is marketed in the United Kingdom and Canada. In Table 1 are shown the production, the exports and the destination of these exports.

TABLE 1.

British Guiana Sugar Production and Exports.

Year	Production (Tons)	Exports (Tons)	Exports expressed as percentage of production (%)	Exports consigned to U.K. (%)	Exports consigned to Canada (%)
1929	117,254	100,449	85.7	27	73
1930	127,764	114,542	89.7	25	75
1931	126,143	119,346	94.6	32	67
1932	148,634	137,078	92.2	56	44
1933	141,956	127,083	89.5	72	28
Average	132,350	119,700	90.3	42	57

†Meteorological Report, British Guiana, 1933, p. 15.

Average Prices of Sugar "Preferential, c.i.f. London," 1924—33.

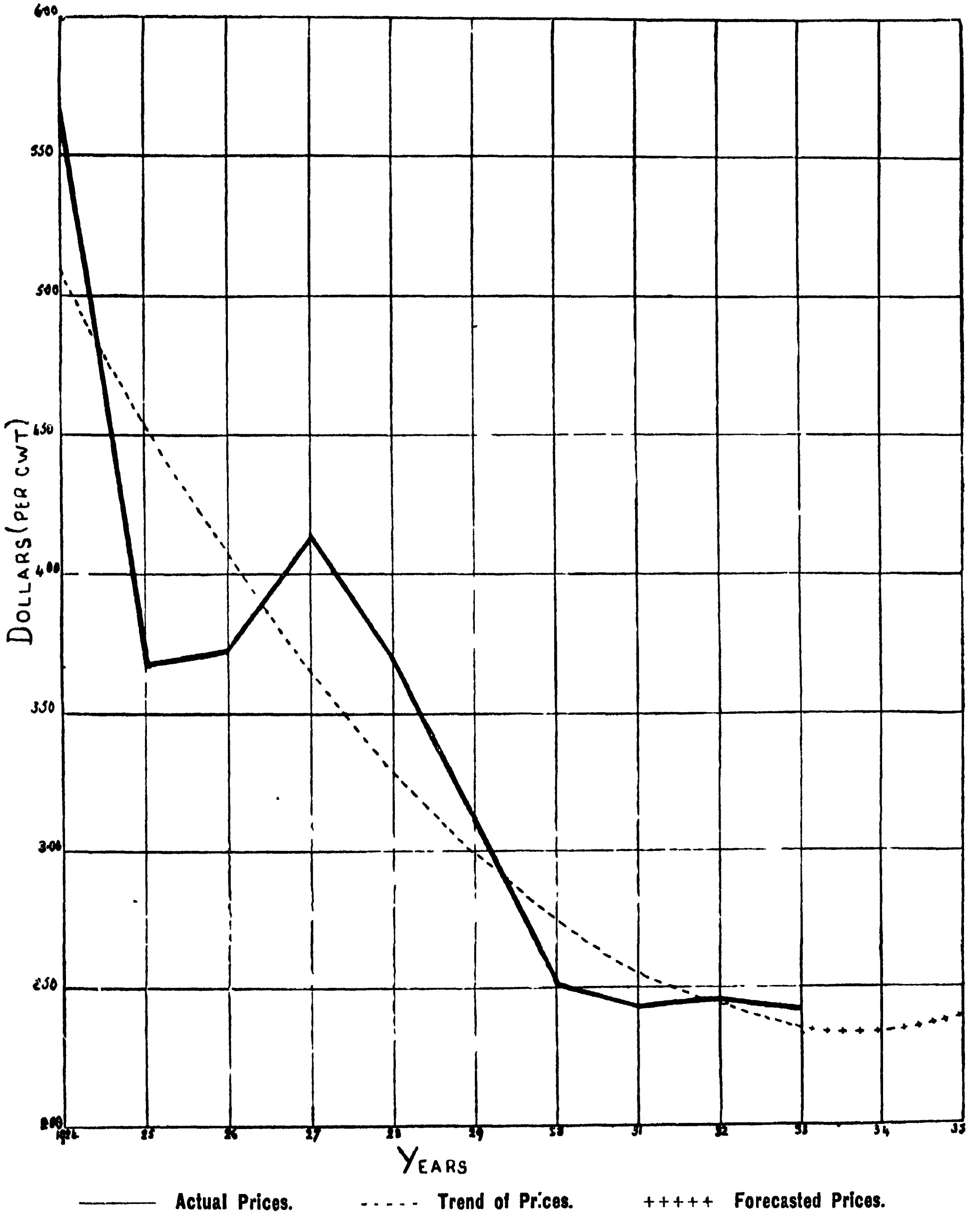


Fig. 2. There has been a consistent and almost steady rate of decline in the preferential price of raw crystals. Prices during the period were highest in 1924 and lowest in 1931 and 1933. The rate of decline has been 9 per cent. of the average price per annum.

Seasonal Variation in c.i.f. London price of Sugar, 1924—33.

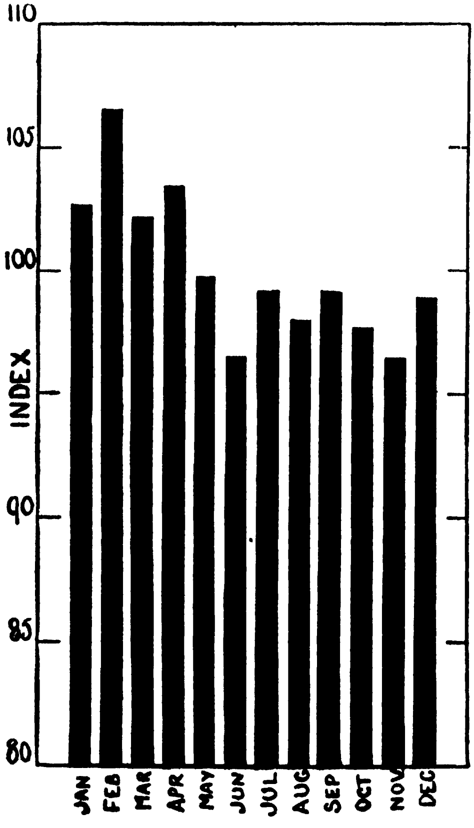


Fig. 3. Sugar prices have been relatively lower in the latter eight months of the year, May to December, with lowest quotations in June and November. Relatively higher prices ruled from January to April.

Seasonal Variation in Sugar Shipments from British Guiana, 1923—33.

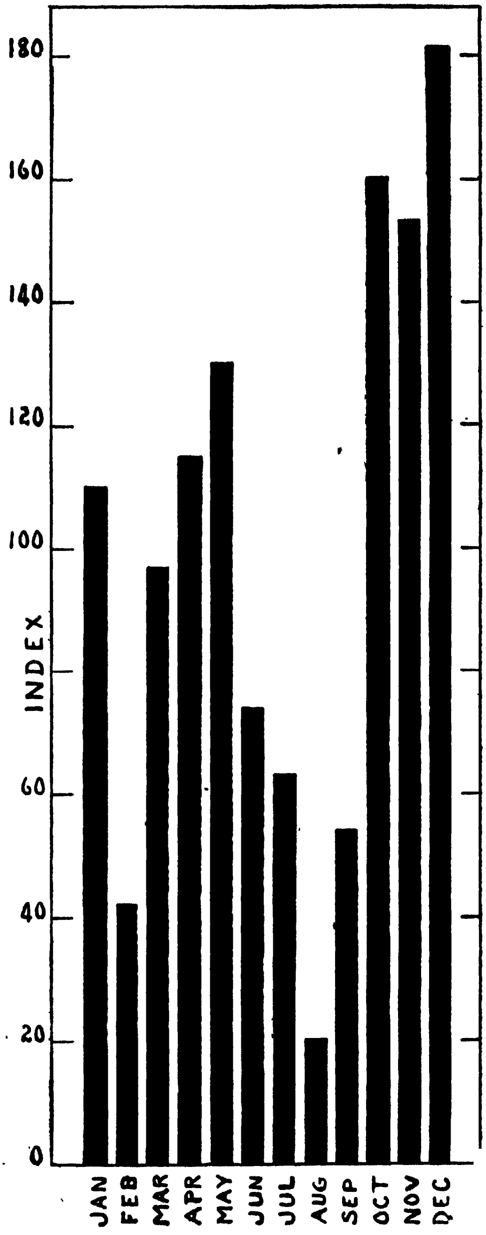


Fig. 4. Highest sugar shipments have taken place from October to January and March to May, the lowest from June to September and in February.

YEARLY PRICE FLUCTUATIONS.

The prices* studied (see Table 2) are those for "preferential, c.i.f. London" for the ten-year period 1924—1933; monthly and yearly averages were calculated from the fortnightly quotations given. It was at first anticipated that it would be possible to make a study of a longer period but complete records were not available in British Guiana for years prior to 1924. On the other hand, it is questionable whether there might not have been a tendency for the inclusion of the war years and those immediately following, associated as they were with violently fluctuating prices, to mask the effects which are to be anticipated in a more stable period. In Fig. 2, it is seen that the period 1924 to 33 has not been characterised by violent sugar price fluctuation but by a consistent and almost steady rate of decline. The average c.i.f. (London) price for the period 1924—1933 was \$3.38 per cwt. or \$67.60 per ton equivalent to about \$60.00 f.o.b. Georgetown. The average c.i.f. (London) price when weighted according to annual exports was found to be \$3.27 per cwt. or \$65.40 per ton equivalent to about \$58.00 per ton f.o.b. The highest price was received in 1924, \$5.68 per cwt. or \$113.60 per ton equivalent to about \$104.00 f.o.b., and the lowest in 1933, \$2.42 per cwt. or \$48.40 per ton equivalent to about \$42.00 per ton f.o.b. Except for the three years 1926, 1927, 1932, the average price in each succeeding year was below the average price of the preceding year. The equation of secular trend discloses that, for the period, the tendency has been for prices to fall at the rate of 9.0 per cent. of the average price per annum (see Table 2).

TABLE 2.

Prices of Sugar (Raw Crystals) and Rum (White: 10—45 O.P.) and Trends in Prices (Average Annual Change in Price Expressed as Percentage of Average Price).

Year	SUGAR c.i.f. (London) price per cwt. (\$)	RUM Price per gallon *ex* bond (\$)
1923	—	0.55
1924	5.68	0.55
1925	3.66	0.55
1926	3.72	0.55
1927	4.14	0.50
1928	3.70	0.50
1929	3.07	0.49
1930	2.50	0.51
1931	2.42	0.52
1932	2.44	0.52
1933	2.42	0.52
Trend	−9.0%	−0.8%

*West India Committee Circulars 1924—1933. See "Produce Markets Summary."

A straight line (equation : $y = -.303x + 3.38$) when fitted to the yearly price data appeared reasonably satisfactory but, after trial, a section of a second degree parabola (equation : $y = 0.029x^2 - 0.622x + 5.677$; see Fig. 2) was found to give a closer fit and a lower standard error of estimate. As may be seen from Fig. 2 the actual prices are evenly and closely distributed around the calculated curve. The curve, which depicts the trend of sugar prices for the ten-year period, has been protracted and forecast prices for 1934 and 1935 shown. It may be pointed out that the straight line did not prove as satisfactory when protracted and tended to decline to unreasonably low values in 1934 and 1935. For these forecasts no greater reliability is claimed than that, if the trend of prices within recent years is maintained, the average c.i.f. (London) price for preferential raw crystals in 1934 would be about \$2.35 per cwt. and in 1935 \$2.39 per cwt. The calculations used in this paper were made during 1934 and cover the period ending 1933 ; the 1934 complete figures have since become available and the average price for the year was \$2.10 per cwt., the forecast being \$2.35 per cwt. as mentioned above.

SEASONAL (MONTHLY) VARIATION.

In Fig. 3 are shown the c.i.f. (London) monthly prices (with trend eliminated) expressed as percentages of the average price. It may be seen that prices have been lowest in the later eight months of the year, May to December, with the lowest quotations in June and November. The price in each of the months January, February, March and April has been above the price in any month from May to December ; in general, February is the month in which highest quotations have been made. There may, then, be said to have been two price periods : a higher price period from January to April during which quotations fluctuated on a comparatively higher level and a slightly depressed price period from May to December during which quotations fluctuated on a comparatively lower level. It may be of interest to consider in this connection the harvesting periods of suppliers of raw sugars to the United Kingdom and these are shown in Table 3.

There are two grinding seasons in British Guiana, the spring and the autumn. In the neighbouring West Indian islands, and in many of the important cane-producing countries of the world, the crop is harvested in the spring. The claim has frequently been advanced that the adoption locally of this routine would operate for greater efficiency in sugar production, and in support of this claim it has been pointed out that British Guiana juice purities are normally higher in the spring, than in the autumn, crop. There are, however, certain considerations which appear to justify the existing practice : the labour supply is stated by the sugar estates to be inadequate to permit a 24-hour factory day which is necessary if grinding is to be completed in the spring ; a larger factory unit, with higher capital investment, is required if the existing practice is changed and grinding activities concentrated into three to four months of the year ; the present outlay for cane transportation (for punts, etc.) will have to be increased ; the autumn field yields on account of the mid-year rains are big enough to offset the poorer juice and, according to a recent statistical examina-

tion, the sugar yield per acre in the autumn is at least as high as, if not higher than, in the spring; sugar obtained from the autumn crop can take advantage of the January-April prices (See Fig. 3).

TABLE 3.

Sources of Raw Sugars Imported into the United Kingdom and Seasons of Harvesting of the Exporting Countries.

Exporting Countries	Imports into United Kingdom: Average Imports* 1929-33 (Tons)	Imports into United Kingdom: Per cent. total imports (%)	Harvesting period†
European Countries	124,399	6.2	
Java	96,375	4.8	May-November.
Cuba	664,232	33.0	December-June.
Haiti and San Domingo	204,136	10.1	December-June.
Peru	161,613	8.0	January-December.
Brazil	30,955	1.5	October-September.
Union of S. Africa	91,441	4.6	May-January.
Mauritius	193,303	9.6	August-January.
Australia	200,585	10.0	June-November.
British West Indies } British Guiana } British Honduras }	145,045	7.2	January-June; Oct.-Dec.; May-June‡; January-June.
Other Countries	100,255	5.0	
Average Total Imports	2,012,339	100.0	

The seasonal variation in sugar shipments is indicated in Table 4 (average monthly exports in tons) and the index of seasonal variation is shown in Fig. 4. Highest shipments are seen to occur from October to January and March to May and lowest shipments in February and from June to September.

*Compiled from annual returns published in **The International Sugar Journal.**

†Extracted from **Willett and Gray's Estimates of Sugar Crops of the World.**

‡The harvesting seasons in this Colony could at present be more accurately classified as mid-September to mid-December and February to mid-May, but this modification does not materially affect the point of discussion.

TABLE 4.

Average Monthly Exports of Sugar, Rum and Molasses from British Guiana. (1923—33).

Month	Sugar (Tons)	Rum (Proof Gallons)	Molasses (Gallons)
January	9,586	87,108	365,959
February	3,572	50.088	162,420
March	8,489	101,964	209,950
April	10,174	103,783	406,323
May	11,491	116,387	275,141
June	6,608	48,874	388,745
July	5,632	96,062	133,971
August	1,868	25,401	132,425
September	4,901	53,739	108,017
October	14,310	45,898	436,769
November	13,742	100,642	510,732
December	16,290	50,522	394,312

RUM.

TRADE.

The sugar estates manufacture rum from their molasses (vacuum pan). A white rum is produced for the local trade but is afterwards diluted, coloured, flavoured and sold under different brands by the retail dealer ; a medium coloured rum is produced for the United Kingdom market and a deeply coloured for the Canadian.

A distillery tax of one-half cent per proof gallon is paid by the producing estate on all rum manufactured. The existing tariff (August, 1934) on rum imported into the United Kingdom is about forty times the original cost (see Table 5). For the local trade, the rum, after the payment of the distillery tax, is despatched to the estate's town agent and placed in bond. Sales are then made *ex* bond to merchants or retail dealers. The dealer before removal of the rum from bond must pay the excise duty—$4.50 per proof gallon. It is the prices, paid *ex* bond by the dealer, which are here examined and depicted in Fig. 5.

TABLE 5.

Preferential Tariff (Dated August, 1934) on Rum Imported into the United Kingdom.

Period for which warehoused	Bottled Rum ($)	Rum in Casks ($)
Under 2 years	18.08	17.84
2 years but under 3	17.96	17.72
3 years and over.	17.72	17.48

Ex bond prices of Rum (White: 10—45 O.P.) in British Guiana, 1923—33.

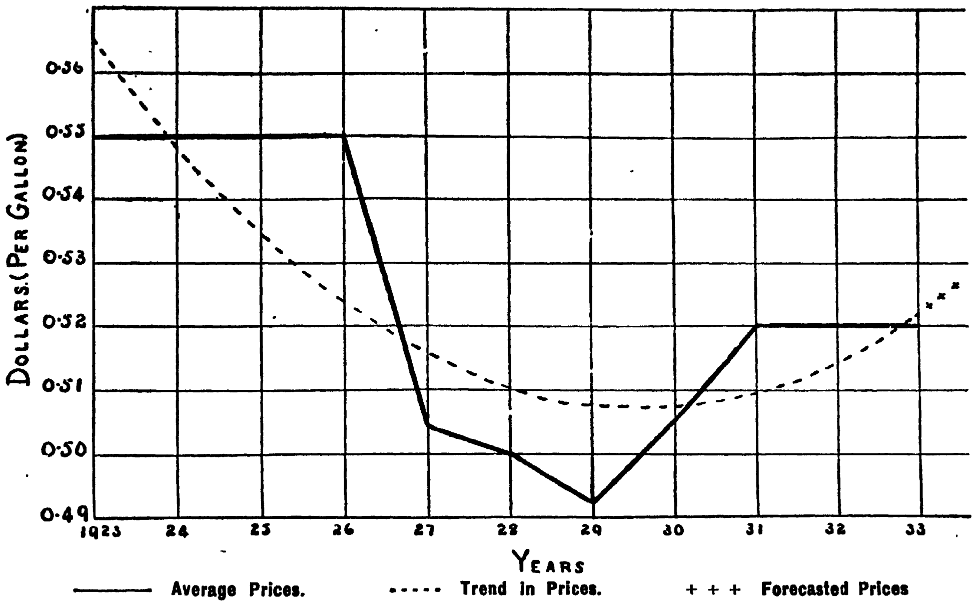


Fig. 5. There has been practically no variation in the price of rum. The difference between lowest and highest prices has been less than six cents per gallon. The trend has, however, been downward, at the rate of 0.8 per cent. of the average price per annum.

Seasonal Variation in Price of Rum (White: 10—45 O.P.) in British Guiana, 1923—33.

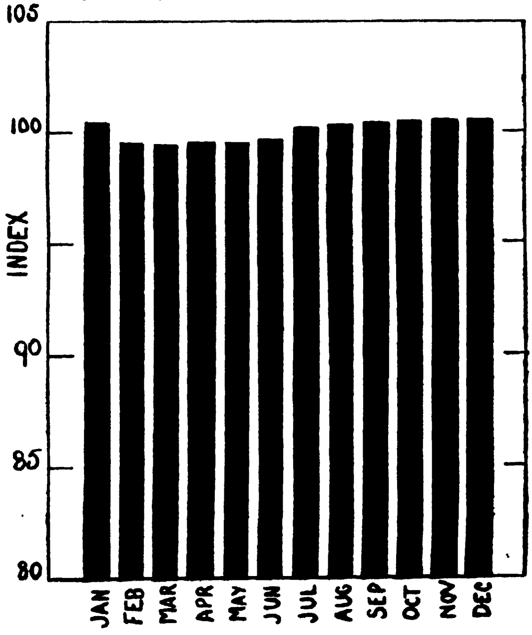


Fig. 6. There have been comparatively no month to month changes in the price of rum.

Seasonal Variation in Rum Shipments from British Guiana, 1923—33.

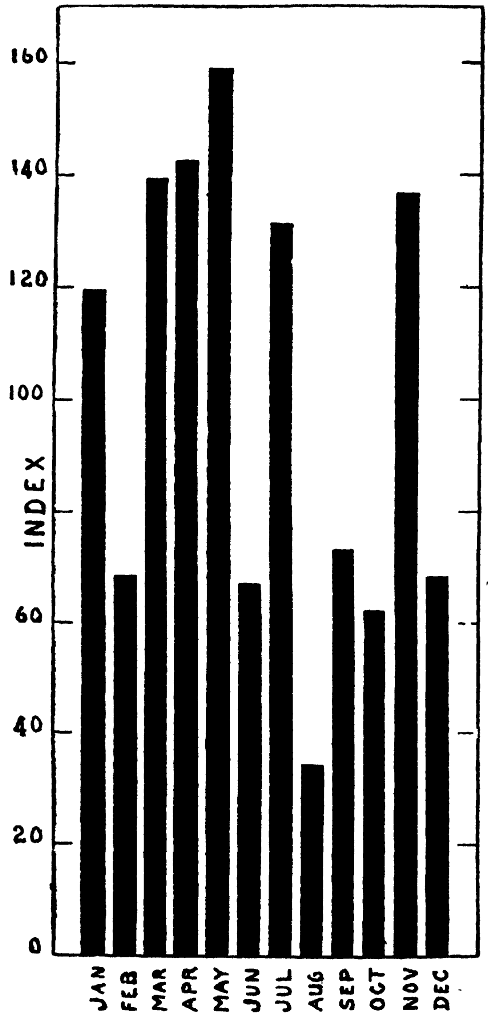


Fig. 7. March to May has been the period of highest rum shipments, January, July and November being also months of high shipments. August to October, and December, February and June were months of relatively low shipments.

Seasonal Variation in Molasses Shipments from British Guiana, 1923—33.

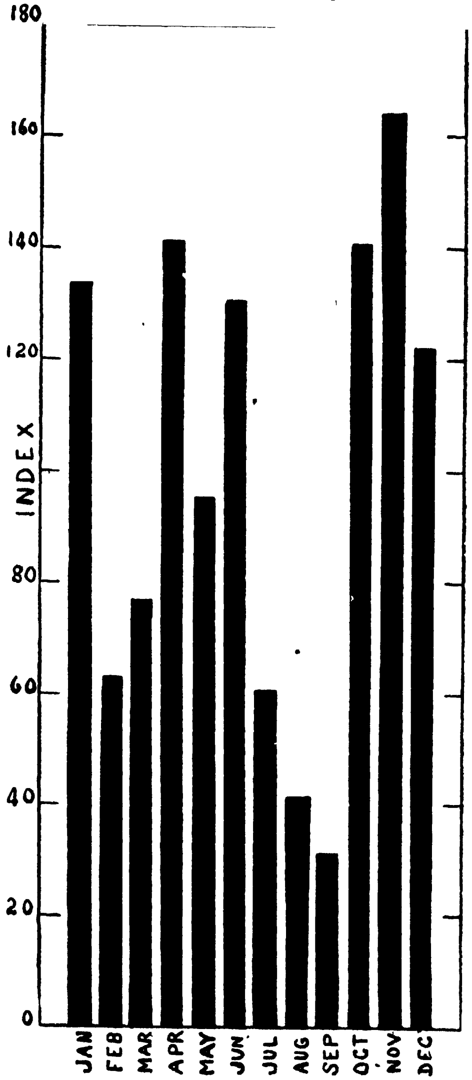


Fig. 8. There have been two periods of high molasses shipments, October to January and April to June. From July to September there have been lowest shipments.

Most of the rum produced locally is exported (see Table 6). The United Kingdom is the largest importer from British Guiana but is also the chief supplier of rum to Canada; it is probable, therefore, that a larger proportion of British Guiana rum finally reaches Canada than is indicated in Table 6.

TABLE 6.

British Guiana Rum Production and Exports.

Year	Production (Pf. gals.)	Exports (Pf. gals.)	Exports expressed as percentage of production (%)	Exports consigned to U.K. (%)	Canada (%)	B.W.I. (%)	Foreign Countries (%)
1929	1,838,353	1,109,482	60.4	62	8	5	19
1930	1,571,371	846,319	53.9	64	7	5	17
1931	1,002,267	722,076	72.0	65	6	4	21
1932	840,617	645,511	76.8	64	2	3	24
1933	1,239,355	883,019	71.2	57	1	2	31
Average	1,298,393	841,281	66.9	62	5	4	22

YEARLY PRICE FLUCTUATIONS.

The prices studied refer to "Rum—White in Hogsheads—10 to 45 O.P. for local consumption." C.i.f. (London) quotations might have been preferable in order to compare, on the same basis, rum price fluctuations, if any, with the sugar price fluctuations which have been previously considered. On account of increasing rum stocks in the United Kingdom rum sales have been slow and quotations have not always appeared regularly. In addition, as stocks of rum have been warehoused for a long period and as prices fluctuated considerably according to the age of the rum it was not easy to obtain average monthly quotations. Although quotations have been given in the *Commercial Review* for rum for export, rum has been shipped largely on consignment. It therefore seemed more expedient to use quotations for domestic sales.

The average yearly prices have been plotted in Fig. 5. There has been practically no variation in price. It will be noted that the difference between lowest prices (for the period 1927-30) and the highest prices (1923-26) has been under six cents per gallon (10 to 45 O.P.). The average price was $0.52 per gallon (10 to 45 O.P.) and the equation of secular trend discloses that there has been a tendency for prices to fall almost negligibly at the rate of 0.8 per cent. per annum. A straight line when fitted to the data did not give a close enough fit; the curve shown in Fig. 5 (plotted from the equation: $\log. y = 0.0011 x^2 -$

0.0164 x + 1.7675) appeared to indicate the trend more accurately and has been protracted to 1934 and 1935. If the trend as depicted by the curve is maintained there should be a small rise in price of rum in 1934 and 1935, but it has been indicated above that the fluctuations in rum prices have been small and any appreciable increase or decrease is unlikely.

SEASONAL (MONTHLY) VARIATION.

Fig. 6 shows that there is comparatively no month to month changes in the price of rum in British Guiana. This lack of variation was to be anticipated as the rum producers of the Colony have reached an agreement in regard to prices at which rum should be released to the local trade. In Table 4 are shown the monthly fluctuations in rum shipments. For the period studied, March to May was the quarter in which most shipments were made, January, July and November being also months of high shipments; August and October, December, February and June were the months in which lowest shipments were made.

MOLASSES.

Molasses is sold at a contract price and there are, in general, no fluctuations in prices on the local market. It, however, seemed of possible interest to ascertain the monthly variation in shipments (see Table 4). There are two periods of high shipments, October-January and April-June (see Fig. 8).

PADI.

TRADE.

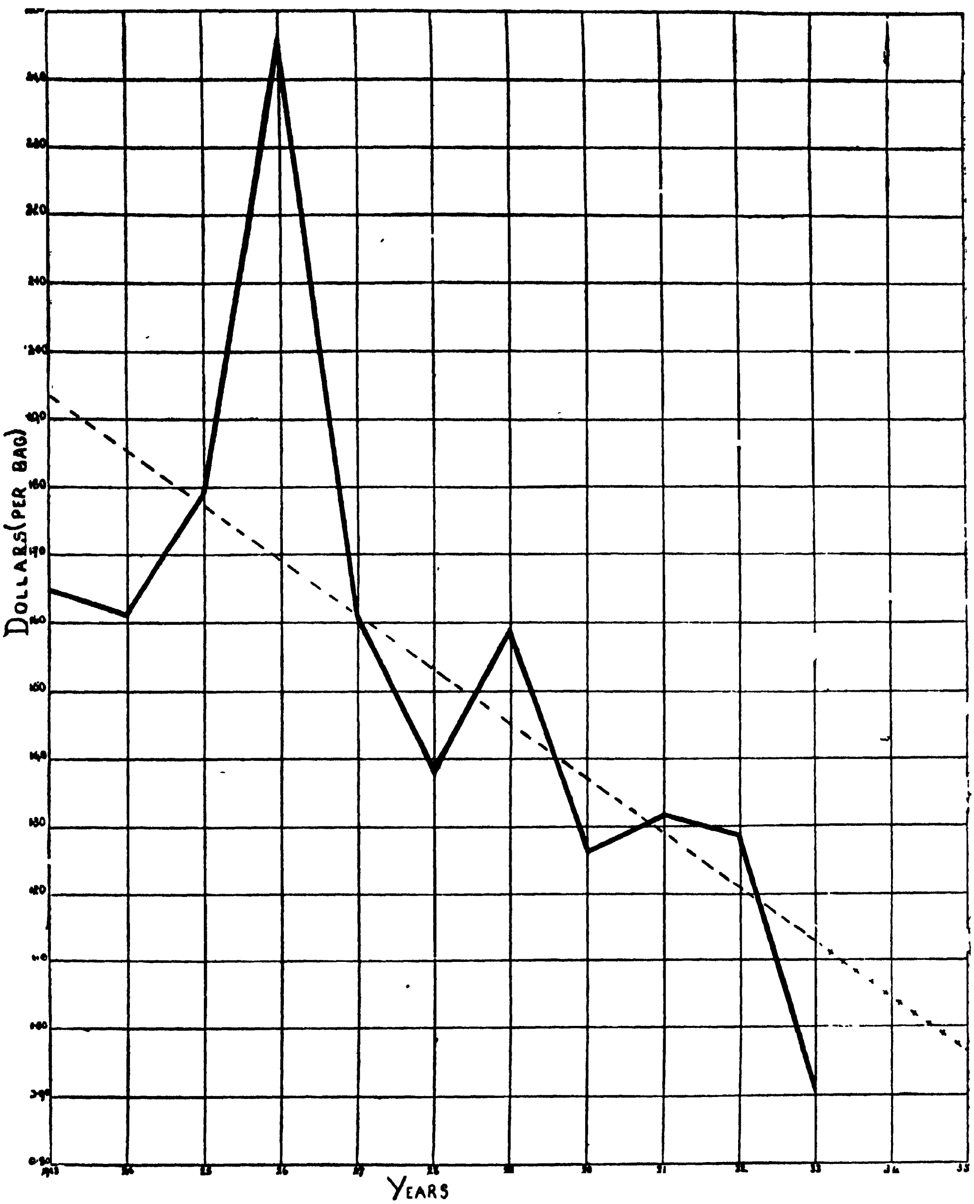
Padi is the term used in British Guiana and in some other countries for unmilled or rough rice. Rice, in this Colony, is almost entirely a small farmers' industry. Some of the padi grown is sold to the mills but a fairly high proportion while still the property of the grower is converted into milled rice. Padi as such is not exported; a limited quantity is used for stock feed. In Table 7

TABLE 7.

Estimated Production and Value of Padi (Rough Rice) in British Guiana.

Year	Estimated Production (Tons)	Average Annual Price: Per bag of 155 lbs. ($)	Average Annual Price: Per ton ($)	Estimated Value of Padi Crop ($)
1930	64,252	1.26	18.21	1,170,028.92
1931	78,424	1.32	19.08	1,496,329.92
1932	84,783	1.29	18.64	1,580,355.12
1933	63,524	0.91	13.15	835,340.60
Average	72,746	1.20	17.27	1,270,513.64

Average Prices of Padi, British Guiana, 1923—33.

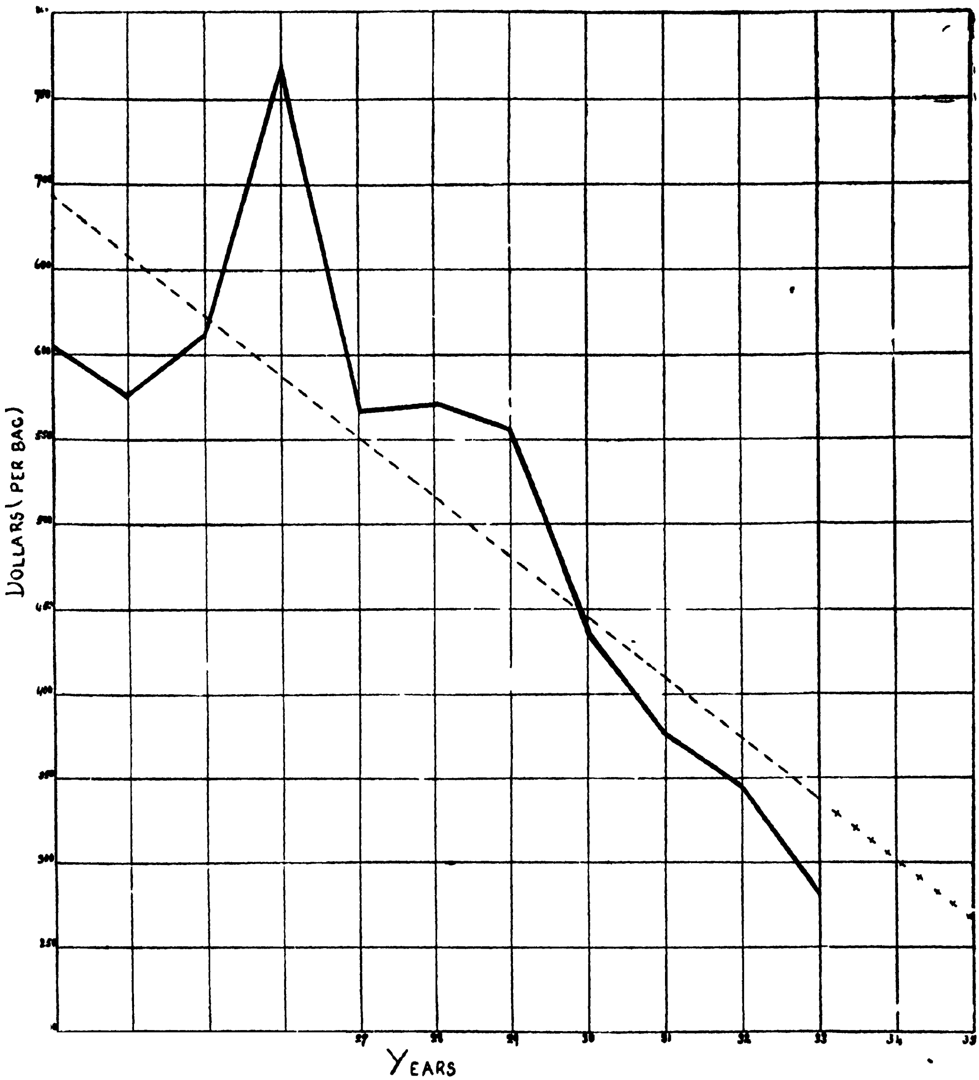


——— Actual Prices. - - - - - Trend in Prices. + + + Forecasted Prices.

Fig. 9. The higher 1925 and 1926 padi prices were due largely to drought conditions. 1926 was the year of highest prices and 1933 the year of lowest. Prices tended to decline at the rate of 5.2 per cent. of the average price per annum.

PLATE X.

Average Prices of Rice, Georgetown, 1923—33.



——— Actual Prices. - - - - - Trend in Prices. + + + + Forecasted Prices.

Fig. 10. 1926 has been the year of highest prices and 1933 the lowest. Prices have declined at the rate of 6.9 per cent. of the average price per annum.

are shown the estimated production of padi for the four year period 1930-33 and the estimated value of the padi crop on the basis of the average annual quotations. The estimated average value of the padi crop for the four years is $1,270,514.

There are, in some districts, two crops grown per year; the autumn crop is the more important and is sown from April to June at the beginning of the long wet season (see Fig. 1). The spring crop, planted only in those districts where the water conserving facilities permit, is sown with the rains of the short wet season in November and December (see Fig. 1). The varieties in general cultivation reach maturity in about five months. The greatest movement of padi therefore takes place in the end of the year dry season—September, October and early November, and, in the case of the spring crop, in the early dry season—March and April.

Yearly Price Fluctuations.

The prices studied (see Table 8) are those appearing in the *Commercial Review*. The quotations are included in the "Demerara Market Report" and refer to "Padi, per bag of 155 lbs. gross." The average price during the period is $1.53 per bag, but there has been a marked downward trend (see Fig. 9). As

TABLE 8.

Prices of Padi and Rice, and Trends in Prices (Average Annual Change in Prices Expressed as Percentage of Average Price).

Year	Rice: Price per bag (Georgetown) ($)	Padi: Price per bag (Georgetown) ($)
1923	6.06	1.65
1924	5.75	1.61
1925	6.10	1.79
1926	7.70	2.46
1927	5.65	1.61
1928	5.70	1.37
1929	5.56	1.59
1930	4.33	1.26
1931	3.76	1.32
1932	3.44	1.29
1933	2.80	0.91
Trend	−6.9%	−5.2%

prices have declined and production increased especially within recent years, the ordinary average price ($1.53) may give a misleading indication of the prices actually received. The weighted average price was therefore computed and found to be $1.34 per bag. It can be observed that although the average price was $1.34, prices declined from $1.65 in 1923 to $0.91 in 1933. The higher prices in 1925 and 1926 are to be explained by the drought conditions experienced. The secular trend for the eleven-year period was found to indicate a decline in prices at the rate of 5.2 per cent. per annum (see Table 8). 1926 was the year of highest prices (for the period under consideration) while the year of lowest prices was 1933. The trend line (equation $y = - 0.08 x + 1.53$) is seen to give a reasonably satisfactory fit to the actual price quotations (see Fig. 9). As so close a fit was obtained and as the trend appeared to be clearly defined the trend line was protracted for 1934 and 1935; on this basis the forecast prices for 1934 would be $1.05 per bag and for 1935 $0.97 per bag. The 1934 actual prices for padi have become available since these calculations (based on quotations for the period 1923—1933) were made. The average quotation for 1934 as stated in the *Commercial Review* was $1.20.

SEASONAL (MONTHLY) VARIATION.

In Fig. 11 each month's average padi price (with secular trend eliminated) is expressed as a percentage of the average price. The season of highest padi prices was July to October, with July and August higher than September and October; the season of lowest prices was November to January. This price variation may be considered to indicate the comparative importance of the autumn crop; the high prices in July and August are attributed to the absence of surplus padi, as by that time of the year most has been already sold for milling or used for sowing the autumn crop in April, May and June. The small reduction in price in September is associated with the arrival at the mills of the early crop. That a greater decline does not take place in October is due probably both to the fact that only limited areas are harvested as early as September and to the fact that mills are competing to replenish their stocks. By November most of the crop is harvested, is being offered to millers, and there is a collapse in price (see Fig. 11). This marked seasonal variation in the price of padi is doubtless connected with the absence of credit facilities adequate enough to enable the average grower to hold his padi, if necessary, for a somewhat longer period after harvesting. By February most of the surplus padi is apparently in the hands of those who can afford to hold it. The additional supplies from the spring crop (available in March and April) are not important enough materially to affect the situation and prices gradually rise until the season July to October is reached.

These figures would seem to indicate that the grower who intends to sell his crop as padi should either plant early enough to dispose of his crop not later than October or if his crop is not early enough, to hold his padi until February or March. The former course is preferable because there are two important objections to the latter :—

Seasonal Variation in Price of Padi, British Guiana, 1923—33.

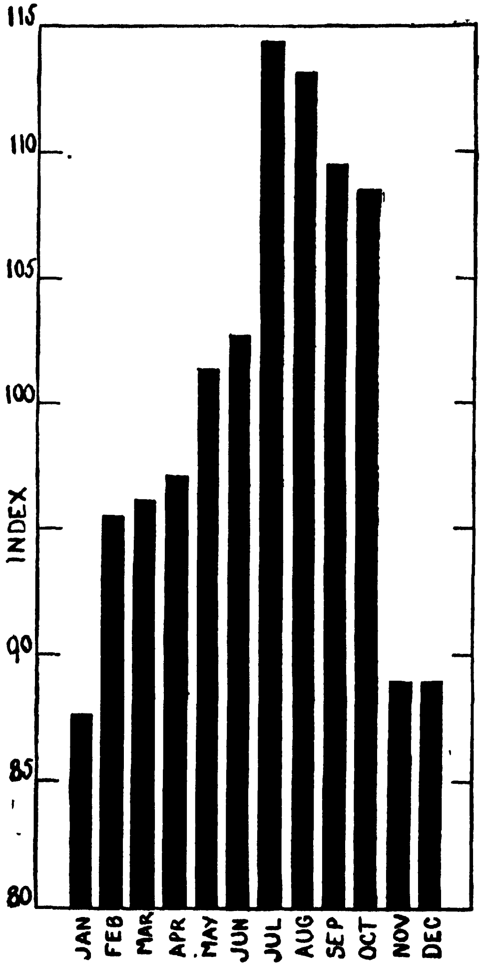


Fig. 11. The season of highest padi prices has been July to October, with July and August higher than September and October. Relatively lower prices have ruled from November to January.

Seasonal Variation in Price of Rice, Georgetown, 1923—33.

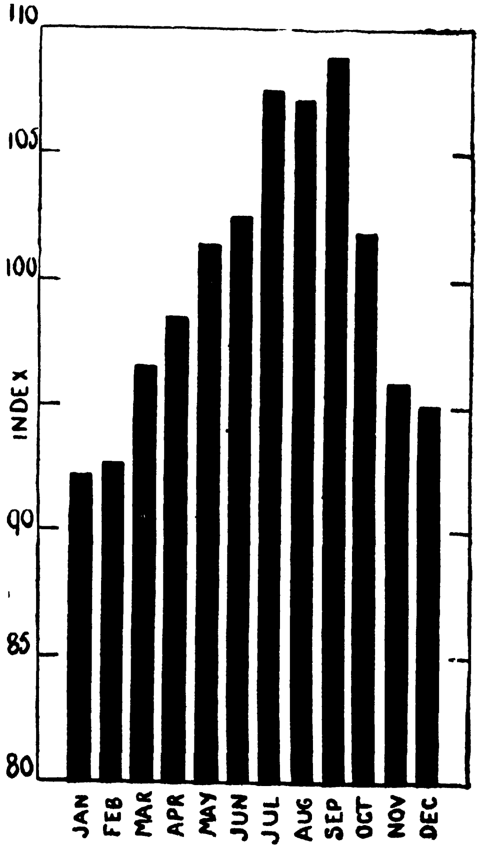


Fig. 12. Rice prices have been highest from July to September and lowest from November to February.

Seasonal Variation in Rice Shipments from British Guiana, 1923—33.

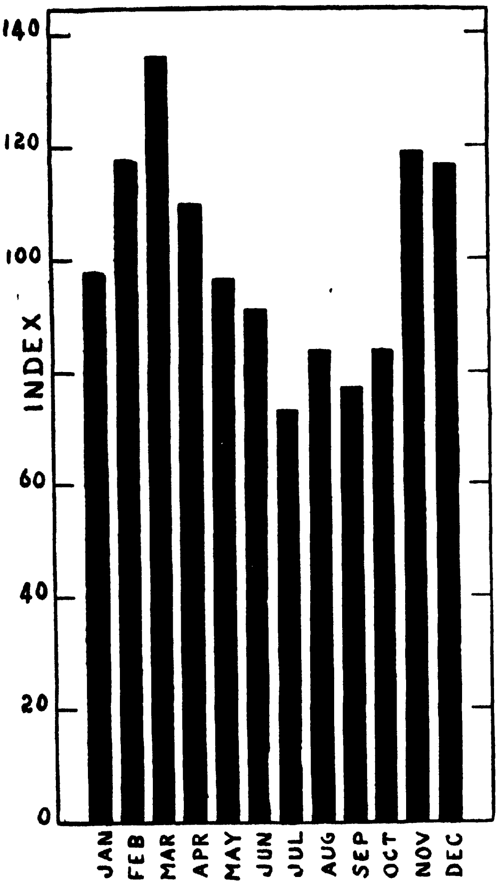


Fig. 13. Highest rice shipments have taken place from November to April, with peak shipments in March. Relatively low shipments have been made from July to October.

cx25

Seasonal Variation in Shipments of Rice to Trinidad from the East (Burma, etc.), 1929—34.

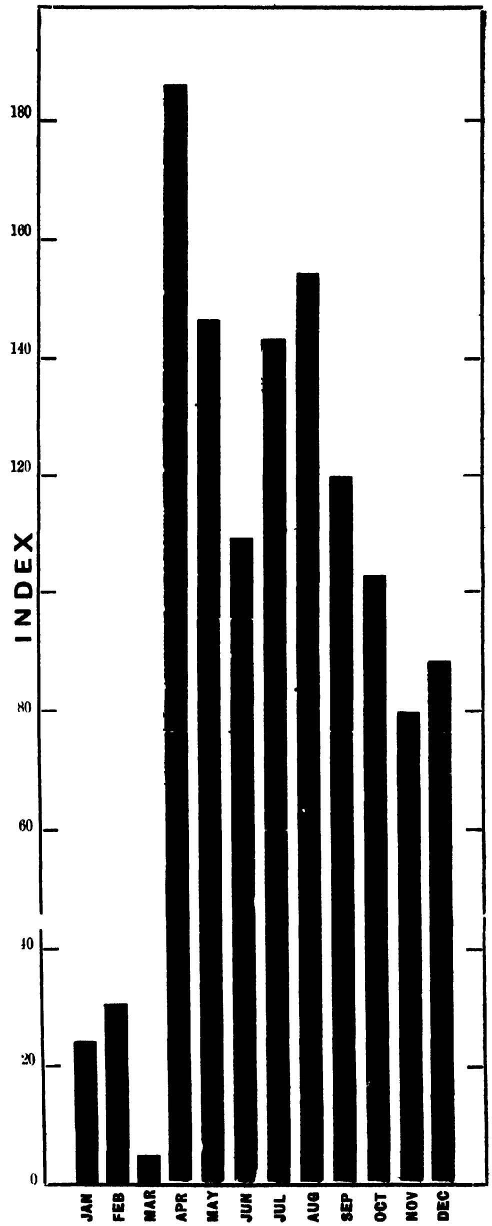


Fig. 13A. Rice shipments to Trinidad from the East have been highest from April to September, relatively lower from October to December and almost negligible from January to March.

(1) only a financially independent grower can hold his padi for so long a period ;

(2) the rice weevil (*Calandra oryzae* L.) causes a considerable amount of damage to padi stored for long periods.

There is no regular export of padi, shipments being made only spasmodically, and no attempt has been made to study seasonal variation in shipments.

RICE.

TRADE.

Rice is the most important vegetable item in the local dietary and next to sugar is the most important commodity in the Colony's export trade. In Table 9 are shown the rice estimated production, value and exports.

There are a large number of small mills throughout the rice-producing areas and a considerable amount of overlapping in regard to the agencies by which the marketing services are performed. The grower may mill his padi and sell the rice or may sell his padi to the miller. The merchant, who is the most important distributor, both for the local and the export trade, may in consequence make his purchases from the miller and/or the grower. The merchants largely control the export trade but the miller is also frequently an exporter.

It has been pointed out that padi is harvested in the two dry seasons—September to mid-November and March to April. Dry periods are also desirable from the miller's point of view as most of the rice shipped is parboiled, the padi being soaked in water, steamed and afterwards dried on concrete platforms in the sun ; for the drying process dry weather is essential. Reliable figures on the periods during which milling is done are not available but might prove interesting ; the product is considered to "keep" better unmilled, and an important factor controlling the periods at which milling of padi is begun or discontinued is the demand for rice.

YEARLY PRICE FLUCTUATIONS.

The prices studied (see table 8) are "per bag 180 lbs. gross", average grade, Georgetown. The average price for rice (all grades) during the period was $5.17 per bag, but there has been a marked decline in price during the period. For the reason given above in the discussion of padi prices, a weighted average price was also computed for rice and found to be $4.38 per bag. It can be observed that although the average price for the eleven years studied was $4.38, prices declined from $6.06 in 1923 to $2.80 in 1933.

As in the case of padi, 1925 and 1926 were years of high prices due largely to dry weather conditions. From 1928 the average price in each succeeding year has been below the average price of the preceding year. The straight line trend

TABLE 9.

British Guiana Rice Production and Exports.

Year	Estimated Production (Tons)	Average Price		Estimated Value of Total Rice Crop ($)	Exports		Per cent. total exports consigned to		
		Per bag of 180 lbs. ($)	Per ton ($)		Tons	Expressed as % of production (%)	B.W.I. (%)	U.S.A. (%)	Other Foreign Countries (%)
1930	38,551	4.33	53.88	2,077,127.88	22,480	58.3	87	1	12
1931	47,054	3.76	46.79	2,201,656.66	23,632	50.2	80	2	18
1932	50,869	3.44	42.81	2,177,701.89	28,541	56.1	78	2	20
1933	38,154	2.80	34.84	1,329,285.36	29,120	76.3	74	1	25
Average	43,657	3.58	44.58	1,946,442.95	25,943	60.2	80	1	19

(equation $y = -0.36x + 5.17$) was found to give a reasonably close fit and disclosed a tendency for prices to fall at the rate of 6.9 per cent. of the average price per annum (see Fig. 10). The trend line was protracted to 1934, but not further as it tended to indicate lower prices after 1934 than were considered probable. The forecast 1934 price was $3.02. Since these calculations were completed the 1934 prices have become available and the average 1934 price has been found to be $3.48 per bag.

SEASONAL (MONTHLY) VARIATION.

In Fig. 12 each month's average quotation (with secular trend eliminated) is shown expressed as a percentage of the average quotation for the period. The season of highest prices is July to September and, of lowest, November to February.

The relatively high prices in July to September are attributed to the scarcity of rice locally, but the prices in November, December, January (*i.e.*, immediately after the harvesting of the crop) do not fall lower mainly because there is a demand for British Guiana rice on the West Indian markets at that time. A comparison of the seasonal variation of prices of padi and of rice is interesting. There are not as violent price changes in rice as in padi and this is due, to some extent, to the fact that the sellers of rice are in a better financial position to practise orderly marketing; milled rice can be disposed of through various avenues locally and can be exported while only the miller purchases padi. Padi prices remain high for four months (July to October), rice prices for three (July to September). Padi prices are at their lowest level for three months (November to January), rice prices for four (November to February).

The export trade (see Table 10) has an important influence on local rice prices. The chief importer of British Guiana rice is the British West Indies (see Table 9) on which market Burmese rice is a controlling factor. The monthly variation in the shipments of British Guiana rice is shown in Fig. 13; the seasons during which most rice has been exported from the Colony is seen to be November to April, with peak shipments in March. As it appeared relevant, the arrival of shipments of rice from the East (Burma, etc.,) on the Trinidad market was also studied. It can be seen (Fig. 13A) that most of the rice from the East arrives in Trinidad, and presumably in the West Indies in general, from April to October at the period when the British Guiana autumn or "big" crop is being grown and when least rice is available locally for export. The West Indian buyers are said to look at the end of the year with preference towards British Guiana rice which is harvested from September onwards, while the stocks from Burma at that period are lower and, being older, less in demand. Eastern shipments decline gradually in November and December and almost cease from January to March. It is evident that the British Guiana rice export trade is complementary, on the West Indian market, to the rice trade from the East, since British Guiana exports are highest when Eastern exports are lowest. The orders for Burmese rice which arrives from April onwards are placed at the end of the previous year by Trinidad importers and enquiries indicate that a significant factor affecting the extent of these orders is the estimate, during the period

October to December, of the British Guiana autumn crop. If the British Guiana crop is estimated to be a small one, more extensive orders are placed for Indian rice in October, November, December, so that bigger shipments arrive in the West Indies in April, and *vice versa.*

TABLE 10.

Average Monthly Exports of Rice from British Guiana (1923—1933).

Month	Average Exports (Tons)
January	1,104
February	1,378
March	1,638
April	1,328
May	1,179
June	1,134
July	923
August	1,080
September	1,017
October	1,121
November	1,580
December	1,572

One of the phases of the work of the Department of Agriculture's Rice Station is concerned with the production of an earlier maturing variety.* Apart from other considerations, such a variety is desirable because it would enable a larger percentage of the rice sales to receive the benefit of the September prices. At the present time those growers who have an adequate water supply might advisedly sow with the first rains in April in order to take full advantage of the early-crop price.

COCONUTS, COPRA, COCONUT OIL.

TRADE.

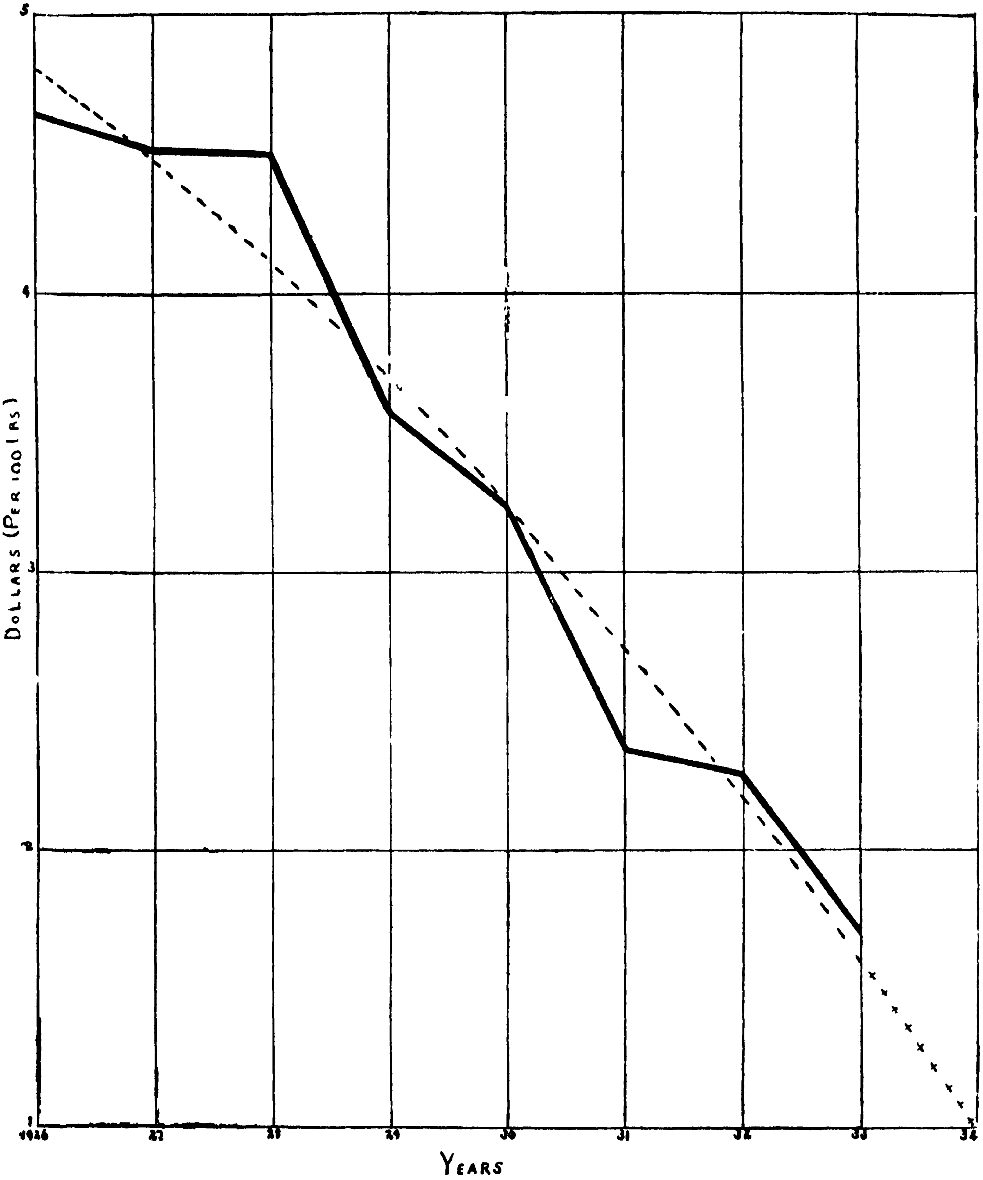
Coconuts are grown in British Guiana in general by small growers. The cultural operations are not intensive. The nuts are in general collected during the dry seasons. Reliable figures on production are not available. The exports and destination of exports are shown in Table 11.

YEARLY PRICE FLUCTUATIONS.

Nuts.—The prices studied (see Table 12) are those appearing in the *Commercial Review*, under the heading "Demerara Market Report, General," and refer to "Selects, per thousand". The average price was $15.08 per 1,000. There have been violent fluctuations in price (see Fig. 15). Prices were comparatively high from 1925 to 1930, but have since fallen sharply and consistently for each successive year—from $20.33 per thousand in 1925 to $8.33 in 1933. The equation of the straight line trend indicated a tendency for prices to fall at

*Rice in British Guiana (Rice Bulletin No. 1.) Introductory Note. Page V.

Average Prices of Copra, Georgetown, 1926—33.

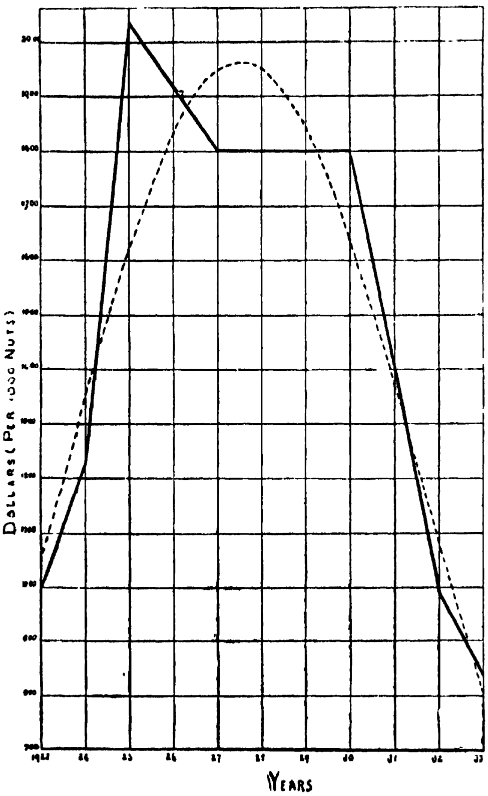


——— **Actual Prices.** - - - - - - **Trend in Prices.** + + + **Forecasted Prices.**

Fig. 14. Copra prices declined consistently at the high rate of 13.6 per cent. per annum. For the period studied the price of each succeeding year was lower than that of the preceding year.

PLATE XIV.

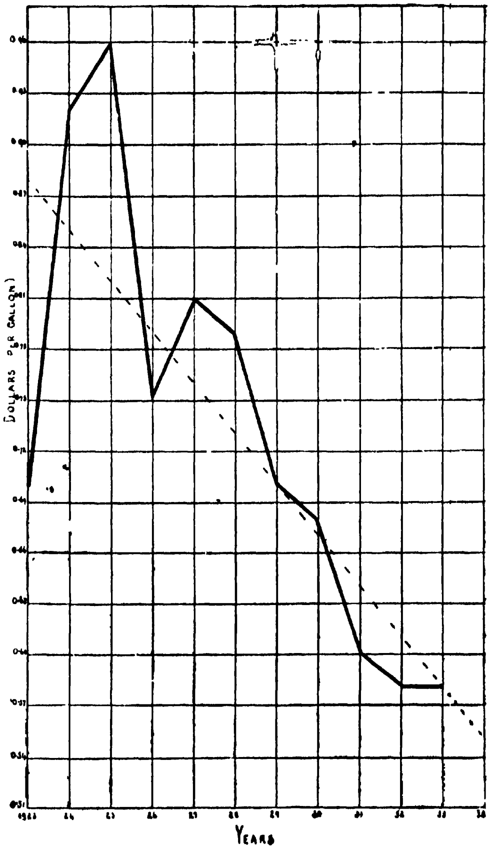
Average Prices of Coconuts, Georgetown, 1923—33.



——— Actual Prices. ---- Trend in Prices.

Fig. 15. Coconut prices have fluctuated violently, were relatively high from 1925 to 1930, but fell sharply from then onwards. Prices tended to decline at the rate of 2.4 per cent. of the average price per annum.

Average Prices of Coconut Oil, Georgetown, 1923—33.



— Actual Prices. --- Trend in Prices. +++ Forecasted Prices

Fig. 16. Coconut oil prices rose in 1924, 1925 and slightly in 1927, but have otherwise steadily fallen. The trend has been a decline at the rate of 4.1 per cent. of the average price per annum.

TABLE 11.

Exports and Destination of Exports of Coconuts, Copra and Coconut Oil from British Guiana.

Year	COCONUTS					COPRA			COCONUT OIL		
	Total Exports	Total exports consigned to :—				Total Exports	Total exports consigned to		Total Exports	Total exports consigned to	
		U.S.A.	Canada	B.W.I.	Other Foreign Countries		U. K.	Foreign Countries		B.W.I.	Foreign Countries
	(Number)	(%)	(%)	(%)	(%)	(Tons)	(%)	(%)	(Gals.)	(%)	(%)
1929	637,812	...	44	50	5	3,759	50	50	20,860	6	94
1930	629,371	4	27	68	1	2,010	66	34	26,377	6	94
1931	1,494,195	...	3	53	44	1,381	68	32	20,742	5	95
1932	962,364	35	8	55	1	757	100	...	19,048	4	96
1933	1,748,175	4	60	36	...	921	100	...	19,962	8	92
Average	1,094,383	9	28	52	10	1,766	77	23	21,398	6	94

the rate of 2.4 per cent. of the average price per annum. A curve appearing to indicate the secular trend satisfactorily was obtained from the equation log. $y = -0.013\,x^2 + 0.144\,x + 0.894$. In the case of prices of other commodities already considered, the trend lines have been protracted (in no instance later than 1935) in an attempt to estimate prices in the immediate future on a basis of price trends for the period under consideration. Prices of coconuts have, however, risen and fallen so sharply that it was decided to make no attempt to protract the trend curve beyond 1933.

Copra. Regular quotations (see Table 12) were not recorded prior to 1926 and hence the prices for the period 1926-33 only are shown (see Table 12).

TABLE 12.

Prices of Coconuts, Copra and Coconut Oil and Trends in Prices (Average Annual Change in Price Expressed as Percentage of Average Price).

Year	COCONUTS Price per 1,000 (Georgetown) ($)	COPRA Price per 100 lbs. (Georgetown) ($)	COCONUT OIL Price per gallon (Georgetown) ($)
1923	10.00	...	0.70
1924	12.25	...	0.92
1925	20.33	...	0.96
1926	19.17	4.64	0.75
1927	18.00	4.50	0.81
1928	18.00	4.50	0.79
1929	18.00	3.56	0.70
1930	18.00	3.25	0.68
1931	14.00	2.36	0.60
1932	9.83	2.28	0.58
1933	8.33	1.70	0.58
Trend	-2.4%	−13.6%	−4.1%

Seasonal Variation in the Price of Coconuts, Georgetown, 1923—33.

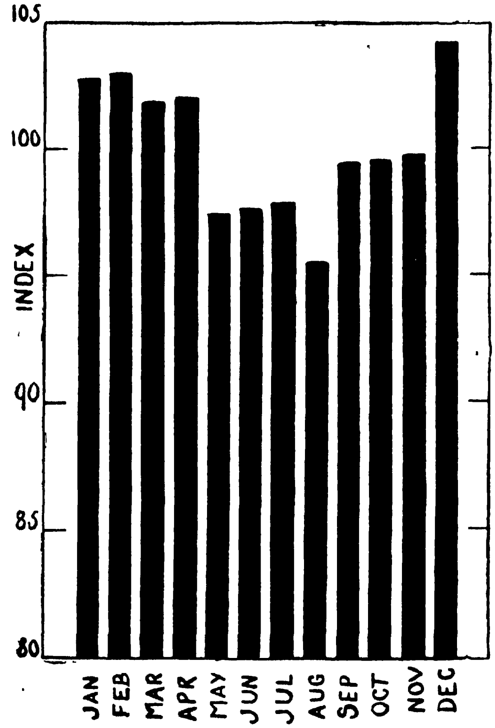


Fig. 17. There has been little variation in the price of nuts. Prices have tended to rise towards the end of the year wet season (December, January, February).

Seasonal Variation in the Price of Coconut Oil, British Guiana, 1923—33.

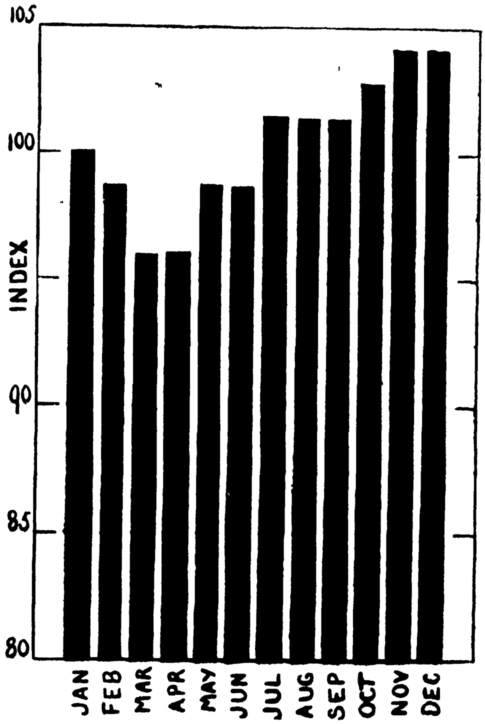


Fig. 18. Prices have been relatively higher from October to December, but the seasonal variation in prices has not been marked.

Seasonal Variation in Price of Copra, Georgetown, 1926—33.

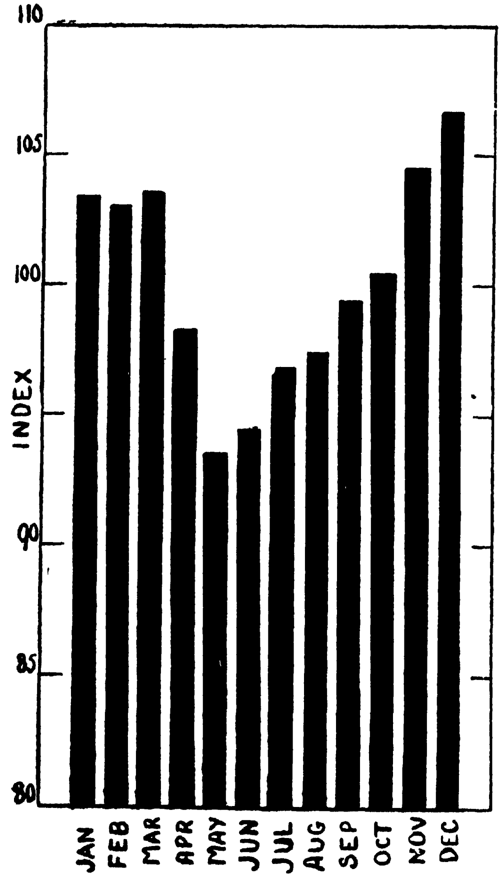


Fig. 19. Copra prices have been relatively high from November to March and lower from April to August.

Seasonal Variation in Copra Shipments from British Guiana, 1923—33.

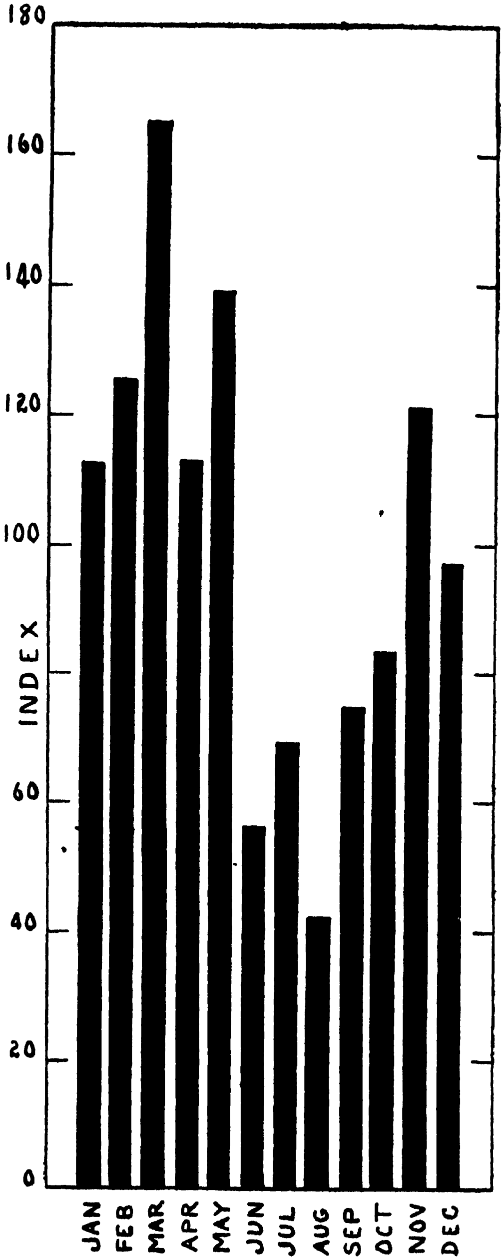


Fig. 20. Copra shipments have been highest from November to May with peak shipments in March. Relatively lower shipments have occurred from June to October.

Quotations appear under the heading "Demerara Market Report, General" and are made for "prime copra per 100 lbs." The average price paid (for the eight years studied) in Georgetown was \$3.35 per 100 lbs., but it can be observed that prices declined from \$4.64 in 1926 to \$1.70 in 1933 (see Table 12). The equation of the straight line trend indicated that the tendency for prices to decline at the remarkably high rate of 13.6 per cent. per annum. The general trend seemed to be well indicated by the curve plotted from the equation $y = -0.02x^2 - 0.27x + 5.09$ (see Fig. 14). The estimate of forecast prices indicated that no attempt should be made to protract this curve beyond 1934; the estimated copra price for 1934 is seen to be approximately \$1.00; the 1934 price has since become available and is found to be \$1.40.

Coconut Oil. Quotations (see Table 12) appear under the heading "Demerara Market Report, Quotations and Remarks" and are made for "Coconut Oil, Local, per gal." In 1930, a firm erected locally a plant for the preparation of a high grade edible oil for domestic consumption. Previous to that date the coconut oil on the market was produced entirely by small home-made equipment.

The average price for the period was \$0.73 per gallon but it can be observed (see Table 12) that prices dropped from \$0.70 in 1923 to \$0.58 in 1933. Prices rose in 1924, 1925 and slightly in 1927, but have otherwise steadily declined (see Fig. 16). A straight line (equation $y = -0.03x + 0.73$) appeared satisfactorily to indicate the trend which is a decline at the rate of 4.1 per cent. per annum. Legislation and other factors seem likely to have so important an effect on the local prices of coconut products that no attempt has been made to forecast prices beyond 1934. The estimated price for 1934 is seen to be \$0.55 per gallon; the 1934 price has since become available and is found to be \$0.54. The estimated price is therefore very close to the actual.

Seasonal (Monthly) Variation.

Fig. 17 indicates that there is little seasonal variation in the price of nuts; prices have tended to rise to a small degree during the end of the year wet season (December, January, February).

Fig. 19 shows the seasonal variation in the prices of copra. Prices tended to rise during the period November to March. In Table 13 is shown the seasonal variation in copra exports. Most copra is shipped from November to May with the peak shipments in March. The June to October shipments are low with a sharp rise in November and then onwards until May (See Fig. 20). Local copra prices are controlled by London quotations. The rise in price for copra from November to March (see Fig. 19) would seem to be caused by the increased demand by merchants for copra to be shipped from November to May, due probably to more attractive prices on the export markets.

TABLE 13.

Average Monthly Exports of Copra from British Guiana (1923—1933).

Month	Average Exports (Tons)
January	145
February	163
March	215
April	148
May	182
June	73
July	92
August	56
September	99
October	111
November	160
December	131

Fig. 18 shows the seasonal variation in price of coconut oil. Prices have tended to be highest from October to December. As the oil to which most of these quotations refer is made direct from nuts and not from copra, the end of the year rise in prices of nuts (See Fig. 17) would be expected to be reflected in the oil prices. Copra prices are however related to oil prices since nuts are converted either into copra or oil. It can be seen that the seasonal variation in price is not marked.

No attempt has been made to study the seasonal variation in shipments of coconut oil and nuts as the export trade is not considered sufficiently important.

COFFEE.

TRADE.

Coffee is cultivated on the pegasse areas of the Colony, chiefly in riparian districts, and is produced, in general, by small peasant proprietors. Of the farming communities in British Guiana, the coffee growers form, probably, the most financially independent group. Reliable production figures for the whole period are not available ; Table 14 shows the exports and destination of exports for the five-year period 1929–33.

The bigger coffee growers own mills and prepare their coffee and that of their neighbours for market. The coffee grower either accompanies his coffee to Georgetown and sells to the best bidder or ships to a town agent who sells on a commission basis. Coffee enters the trade for local consumption either through merchants, shopkeepers, or market stall-holders, but is exported only by a small number of large exporting firms.

Average Prices of Coffee, Georgetown, 1923—33.

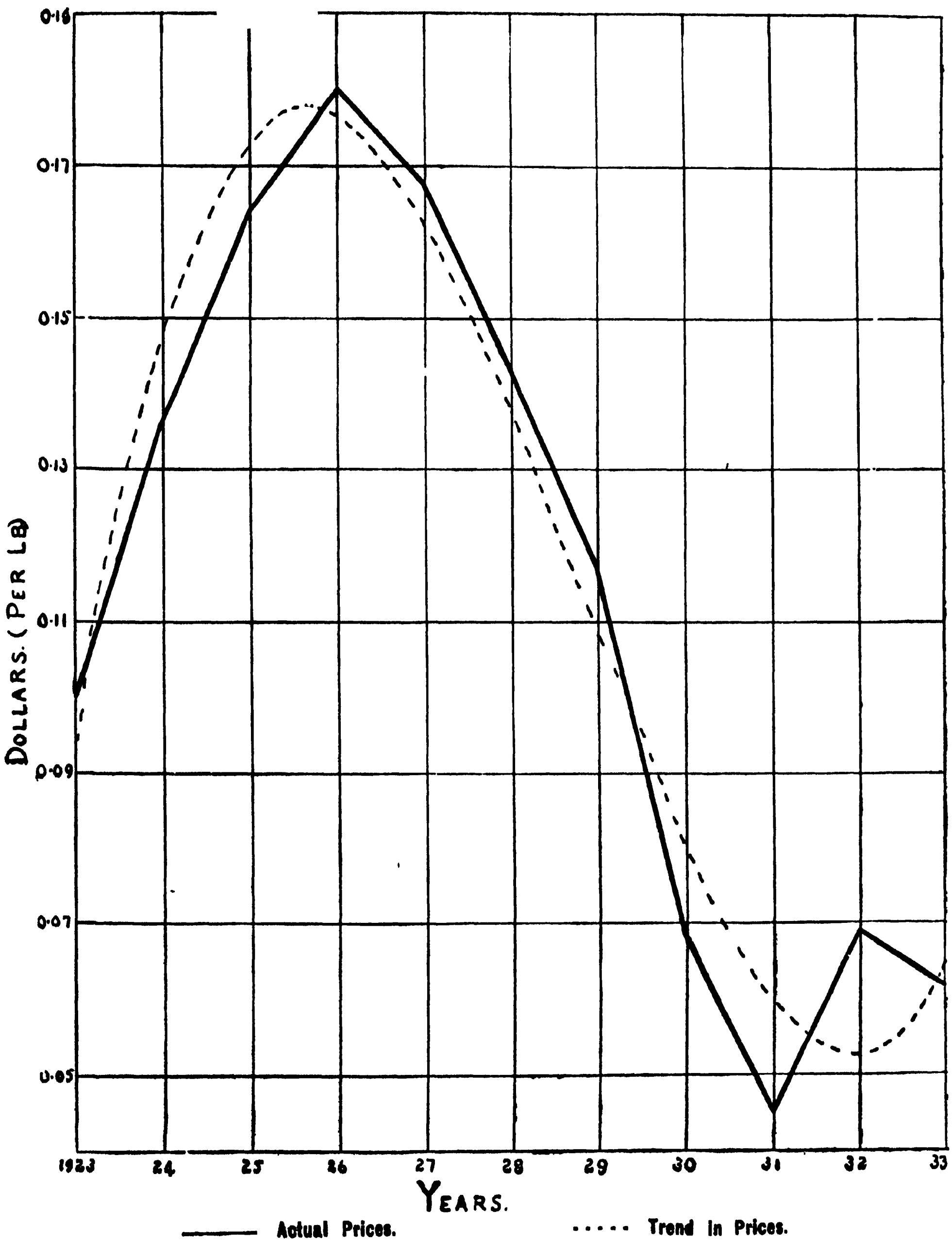


Fig. 21. Coffee prices have risen and fallen more violently than in the case of any other commodity studied. Prices have declined at the high rate of 8.7 per cent. of the average price per annum.

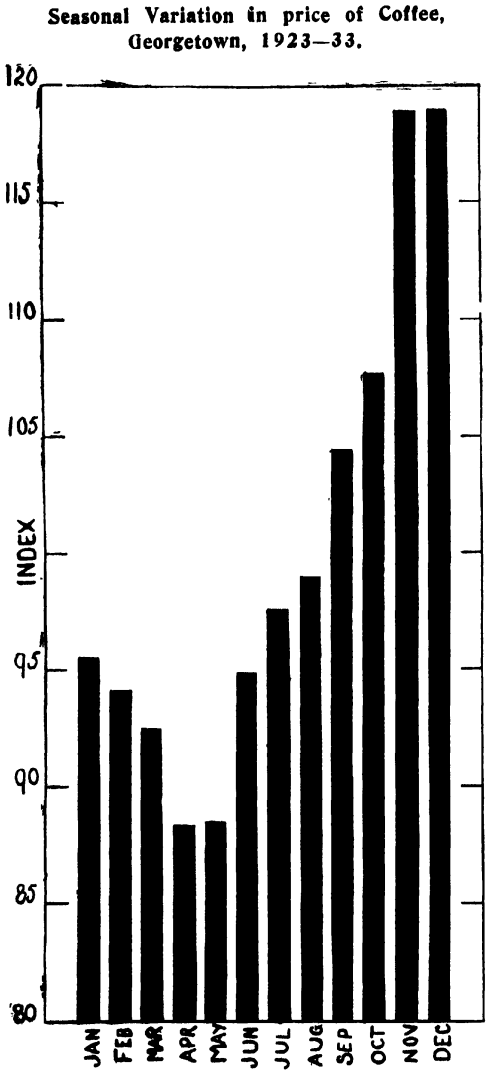


Fig. 22. Coffee prices have been relatively high from September to December, and lowest in April and May.

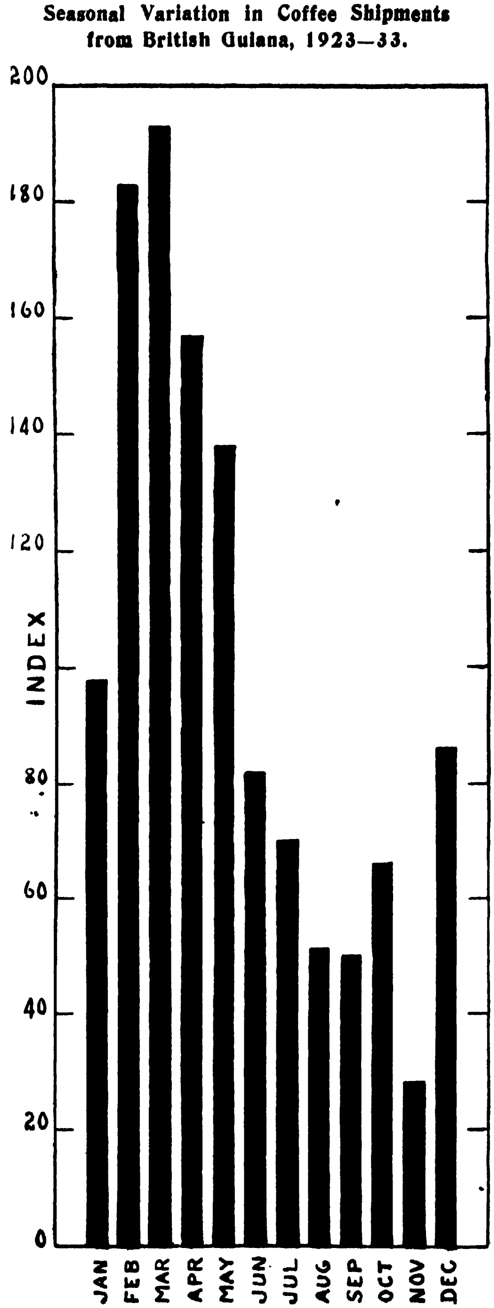


Fig. 23. Coffee shipments have been relatively high from December to May. November has been the mon of lowest shipments.

TABLE 14.

Exports and Destination of Exports of Coffee from British Guiana.

Year	Total Exports (Tons)	Per cent. total exports consigned to				
		U.S.A. (%)	U.K. (%)	Canada (%)	B.W.I. (%)	Other Foreign Countries (%)
1929	405	1	...	1	2	96
1930	164	1	32	4	7	56
1931	355	1	1	2	7	89
1932	471	...	...	24	10	66
1933	510	...	...	38	9	53
Average	381	1	6	14	7	72

YEARLY PRICE FLUCTUATIONS.

The prices studied (see Table 15) are those ruling in Georgetown for average quality, delivered in Georgetown. For the period under consideration coffee prices have risen and fallen more violently than for any other commodity considered (see Fig. 21). Prices in 1926 were 100 per cent. higher than in 1923 and during 1929 prices had again fallen approximately to the 1926 level. By 1931 prices

TABLE 15.

Prices of Coffee and Trend in Prices (Average Annual Change in Price Expressed as Percentage of Average Prices).

Year	Price per 100 lbs. (Georgetown) ($)
1923	10.00
1924	13.67
1925	16.42
1926	18.00
1927	16.75
1928	14.29
1929	11.71
1930	6.83
1931	4.54
1932	6.87
1933	6.18
Trend	–8.73 %.

were more than 100 per cent. less than in 1929. Prices in 1932 and 1933 were higher than in 1931 (see Fig. 21). The average price for the period was $11.39 per 100 lbs., with highest prices in 1926 and lowest in 1931. As coffee production (judged by exports) has increased within recent years, the weighted average price was computed and found to be $10.94 per 100 lbs. Prices from 1930–33 varied between $4.00 and $7.00 per 100 lbs. The equation of the trend line for the period discloses that there has been a tendency for prices to decline at the high rate of 8.7 per cent. per annum. A trend curve (plotted from the equation: $y = 0.10\,x^3 - 2.04\,x^2 + 10.87\,x + 0.27$) was found to give a reasonably close fit to the data (see Fig. 21). As prices changed so markedly and the trend was not considered clearly defined, no attempt was made to protract the curve to estimated values for 1934 and 1935.

SEASONAL (MONTHLY) VARIATION.

Fig. 22 shows the seasonal variation in prices of coffee and Fig. 23 the seasonal variation in shipments.

Coffee prices are highest for the period September to December and lowest in April and May. Shipments begin to rise from December and remain high until May (see Table 16). The rise in prices in September and October appears to be associated with the demand by merchants who are increasing their stocks for future shipments. British Guiana coffee is exported chiefly to northern European countries and the demand for coffee increases during the cold months.

TABLE 16.

Average Monthly Exports of Coffee from British Guiana (1923—33).

Months	Average Exports (Tons)
January	26
February	49
March	52
April	43
May	38
June	22
July	19
August	14
September	14
October	18
November	8
December	24

SUMMARY.

The prices of the chief agricultural products of British Guiana have been examined in order to determine the extent to which prices varied within the year from season to season. The trend in prices of each product was determined and is discussed. The trend lines were in certain cases protracted for one, or, at most, two years. The forecasted prices thus obtained indicate approximately the prices which are to be expected *provided the trend within recent years is maintained.*

For the period studied, the trend in sugar (raw crystals) prices has been a decline at the rate of 9.0 per cent. of the average price per annum; in rum prices, a decline at the rate of 0.8 per cent. per annum; in padi prices, a decline at the rate of 5.2 per cent. per annum; in rice prices, a decline at the rate of 6.9 per cent. per annum; in coconut prices, a decline at the rate of 2.4 per cent. per annum; in copra prices, a decline at the rate of 13.6 per cent. per annum; in coconut oil prices, a decline at the rate of 4.1 per cent. per annum; in coffee prices, a decline at the rate of 8.7 per cent. per annum. The prices of all products studied have tended to fall, but copra and sugar prices have fallen most rapidly. On account of the relative importance of sugar in the country's trade, the movement of sugar prices downward at so violent a rate has been profound in effect.

The seasonal variation in prices is discussed and indicated in bar-diagrams. It is shown, *inter alia*, that average sugar (raw crystals) prices have tended to be relatively higher in London from January to April than from May to December, that average padi prices have been highest from July to October, that padi prices have fluctuated more violently than rice prices, that average rice prices have been highest from July to September, that average copra prices have been highest from November to March, that average coffee prices have been highest from September to December.

The seasonal variation in shipments of agricultural products is indicated in bar-diagrams. Highest sugar shipments have been made from October to December, highest rum shipments from March to May and in November, highest molasses shipments from October to January and April to June, highest rice shipments from November to April, highest copra shipments from November to May, highest coffee shipments from December to May. In addition to showing the indexes of seasonal variation in shipments, the figures for average monthly exports (in tons, gallons, etc.) are given (Tables 4, 10, 14, 16) as it seemed possible that these figures might be of interest to those firms concerned with the handling and shipping of agricultural products.

ACKNOWLEDGMENTS.

The author wishes to thank Prof. J. S. Dash, Director of Agriculture, Messrs. W. S. Jones and H. B. Gajraj for reading over the manuscript and for many helpful suggestions.

REPORTS.

SUMMARY OF CROP REPORTS AND DEPARTMENTAL ACTIVITIES, JANUARY—MARCH 1935.

Compiled by the Deputy Director.

WEATHER.

The rainfall for December and January has been below the average for these months, but for February was nearly twice as much as the average for the past 50 years.

GENERAL CROP CONDITIONS.

Sugar.—As forecasted in the last report, the production of sugar in 1934, due to the effects of the disastrous floods early in the year and the droughty period that followed, fell short of the expected crop by some 20,000 long tons. The British Guiana Sugar Producers' Association reports a total yield of 132,199 long tons from 52,194 English acres reaped. Under normal conditions it was anticipated that the crop would have exceeded 150,000 tons. Coupled with this is the additional expenditure incurred to re-establish the cultivations, etc. To make matters worse, the world market price for sugar fell, during the half-year ended December, 1934, to the lowest level reached in the history of the trade and has since shown no signs of recovery.

The Sugar Producers' Association reports that a weekly average of 862 additional labourers received employment, during 1934, and that the increased expenditure for wages over 1933 amounted to $118,000.

The research work undertaken by the Department in collaboration with the Sophia Experiment Station, has been maintained and further developed. Planters are taking advantage of the information secured and rapid extensions are being made of the varieties Diamond 10 and P.O.J. 2878 which have been recommended by the Department. Many planters are also modifying their manurial practice in conformity with the advice given and it is anticipated that these two factors—new varieties and new fertilizer practice—will have increasingly beneficial effects on the output from 1935 onward.

Five new variety trials have been started at Plantations Lusignan, Uitvlugt, Diamond and at The Sophia Experiment Station, whilst, one variety trial at Lusignan was reaped. The results of this trial are not yet available.

Reaping of farmers' canes which was started in the East Coast Demerara District in November last, had to be discontinued on account of low juice purity. Cane farming at Rosehall Village, Berbice, is gradually on the increase. D. 625 is the standard variety grown. Canes, however, are small, and it has been arranged to supply the more advanced farmers with selected tops with which to estab-

lish nurseries when this present crop comes off in April. Farmers on the East Coast, Demerara, have been supplied with considerable quantities of cuttings of Diamond 10 and P.O.J. 2878 to enable them to start nurseries for the extension of these varieties. These cuttings were obtained from The Sophia Sugar Experiment Station. A total of 1,822 bags of cane tops were distributed to estates during the period under review.

Samples of soil in connection with variety trials laid down on estates have been examined, while samples from two estates have been studied with regard to their potash and phosphate content. Final analysis of fractions of soil from a flooding experiment and the analysis of cane samples in connection with extension of new varieties at Sophia were concluded.

The sugar-cane aphis is still being studied, while breeding and distribution of the Amazon fly parasite were continued both at Headquarters and on the estates.

The average price per ton for sugar during the past three months has been between $32 and $33 as compared with $40–$42 during the *same* period for 1933-1934.

Rice.—The total yield of padi for 1934 was 55,112 tons equivalent to a a yield of 31,067 tons of rice. The total quantity of rice exported during the year amounted to 14,700 tons valued at $583,090 as compared with 29,120 tons valued at $1,062,470 in 1933. The decrease in total yields was entirely due to losses caused by the floods and the prolonged dry weather experienced during the planting of the autumn crop.

Reports from the Districts indicate that the planting of the 1935 spring crop has been carried out under most favourable conditions. After the harvesting of the 1934 autumn crop, planting and setting of nurseries began and with the favourable weather conditions now prevailing, good progress has been made with the cultivations. Consequently, at the end of this month, planting generally will have been completed. On the Essequibo Coast, however, the crop is rather later than usual, whilst very little padi has been planted from Hampton Court to Charity. In the Berbice District there is no spring crop and cattle have been put into graze on fields that were cultivated with the last autumn crop.

A census has been taken of the area under this crop throughout the Colony and it is estimated that, at the end of February, the following acreages were planted and making satisfactory progress.

Essequibo Coast	....	(approximately)	4,000 acres
Leguan	....	,,	1,000 ,,
Wakenaam	....	,,	1,700 ,,
East Demerara	....	,,	500 ,,
West Demerara	....	,,	3,800 ,,
Berbice	....	,,	nil

Following the flood losses special efforts are being made this year with the re-establishment of pure seed blocks in all districts. All rice-growing areas have been visited by the District Staff and arrangements made for this to be carried out. The response and co-operation of the farmers in this connection are satisfactory.

Variety and other trials have been planted at the Henrietta Experiment Station whilst demonstration blocks have been laid down at Sans Souci, Wakenaam, Leguan and at Vreed-en-Hoop. Two variety trials under broadcasting conditions have been arranged in the Berbice District.

At the Rice Experiment Station, Georgetown, 22 sixth generation and 15 fifth generation hybrid plots were planted in observation plots along with the Progeny Row plots in order to get some idea of their comparative yielding value. The sixth generation plots and the majority of the fifth generation plots are now coming true to type and the best plots will be submitted to more exacting variety trials this autumn crop.

Research work on the padi bug and the sodium fluorsilicate and calcium carbonate experiments in connection with the control of the rice-weevil mentioned in previous reports have been continued. The results are to be found elsewhere in this issue. The biology and incidence of the parasites of the rice-weevil are being studied. An extensive investigation of the stem borers of padi and their parasites has been commenced.

Exports of Rice for the three months ending 28th February, 1935, compared with the same period last year are as follows :—

1934/1935

	Whole Grain Super Bags	Super Bags	No. 1 Extra Bags	No. 1 Bags	No. 2 Bags	No. 3 Bags	White A. Bags	White B. Bags	Super Broken Bags	Broken Bags	Total Bags
Dec.	...	1796	1,505	807	4,161	8,772	3	35	...		17,079
Jan.	...	2141	1,797	760	4,490	3,971	...	35	25	3	13,222
Feb.	...	3162	2,408	771	6,188	2,198	60	...	6		14,793
Tot'l	...	7099	5,710	2,338	14,839	14,941	63	70	31	3	45,094

1933/1934

	Whole Grain Super Bags	Super Bags	No. 1 Extra Bags	No. 1 Bags	No. 2 Bags	No. 3 Bags	White A. Bags	White B. Bags	Super Broken Bags	Broken Bags	Total Bags
Dec.	85	1,292	...	1,439	3,949	15,316	63	105	45	90	22,384
Jan.	...	521	...	697	1,328	4,190	23	25	15	55	6,854
Feb.	25	3,497	...	4,951	11,879	15,084	89	4	291	94	35,914
Tot'l	110	5,310	...	7,087	17,156	34,590	175	134	351	239	65,152

After falling to 7/3 per cwt. in November, the Market for new crop Burma Rice took a welcome turn upwards and rose gradually throughout January until it reached 8/9 c.i.f. West Indies, at which level it remained for the latter part of February. This price is equivalent to $3.00 per bag of 160 lbs. c.i.f. Trinidad, compared with $3.20 per bag fixed by the British Guiana Rice Marketing Board. M.S.P. is quoted at 12/6 per cwt. c.i.f. West Indies according to latest advices from London, or $4.30 per bag of 160 lbs. c.i.f. Trinidad. This grade is equivalent to Demerara Super, the price of which is also $4.30 per bag of 160 lbs. c.i.f. Trinidad.

A sample of new crop Indian Rice which has just been received here approximates very closely to British Guiana Grade No. 1. The colour is a trifle darker, but very free from discolouration and breakage and will be a strong competitor against British Guiana Grade No. 2 which is generally sold as its equivalent. It may become necessary later in the year to improve the standard of the Colony's No. 2 and to issue new guide samples with an improved appearance. Whilst it is generally felt that the Colony's cooked product has a superior appearance on the table to, and a better taste than, the Indian article, it must be remembered that rice is not sold cooked and is judged by its appearance as a raw product.

Coconuts.—The average price per ton for copra during the past three months has been between $30—$43 as compared with $30—$31 during the same period for 1933-1934. As a result, farmers who had previously been manufacturing edible oil have again turned their attention to the production of copra.

Coffee.—Harvesting of coffee berries in the North West District, Canals Polder and Pomeroon is in full swing and farmers are, as is customary, more especially in the North West District experiencing a shortage of labour for this work. Prices for good coffee vary from $4.50 to $5.50 per 100 pounds. Considerable time has been devoted by the District Staff in impressing on farmers the necessity for picking only ripe berries, as in many instances, green berries are also picked. This considerably hampers proper curing of the coffee with a consequently lower price for the finished product.

Cacao.—Further inspections have been made to discover strains of Cacao immune or resistant to Witchbroom disease (*Marasmius perniciosus*). Trees that had previously been selected for observation purposes have been periodically inspected.

In the North West District, the acreage under cacao cultivation is on the increase and selected seedlings were distributed to the farmers from the Hosororo Experiment Station for extension purposes.

Bananas.—A census has been taken during the period under review of the number of suckers of Dwarf Bananas in the Colony, with a view to obtaining suckers for organised cultivation at a later date, if satisfactory shipping arrangements can be made for an export trade to European countries. This question is receiving the attention of the Advisory Board of Agriculture.

Citrus.—Yields from the Experimental citrus block at Hosororo, North West District, have been most satisfactory and trees have now been marked from which budwood for propagation purposes can be obtained. Budding operations have been carried out during January both at the Georgetown and Hosororo Experiment Stations from budwood obtained from selected trees at Hosororo. At the latter station some 658 stocks were budded. Instructions in budding have been given to farmers in the N.W.D., whilst two boys are being specially trained in budding for the benefit of the farmers in that area.

Provision Crops.—Excellent crops of sweet potatoes and general provision crops are being obtained in the North West District and at the mouth of the Moruca river. Farmers at the latter place have been paying special attention to the grading of their crops and the prices obtained have well rewarded them for the trouble taken. In Berbice, however, the dry spell during January disheartened farmers engaged in ground provision cultivation and many who began planting crops of sweet potatoes, yams, plantains, etc., abandoned their cultivations. On the West Coast, Berbice, however there is considerable activity in sweet potato cultivation, whilst at Ithaca and Shoemakers' Lust, every effort is being made to extend the present cultivations.

The Plantain Beetle (*Colappis hypochlora*) has been very active of late and much damage has been done to young bunches of plantains. The insect is known to pass its larval stage feeding on the roots of *Paspalum* spp. but so far the immature stages have not been found. Spraying with lead arsenate has been tried but results are not yet available. This matter is under investigation by the Government Entomologist.

Miscellaneous—Papaws.—Selected seed of the "Panama" and "Walcott" varieties were sown together with F_1 seed (obtained by crossing these two types) in order to combine the high yield and large fruit of the "Walcott" with the flavour and keeping qualities of the "Panama." The following additions have been made to the Papaw collection :—

"Mamie"	...	...	British Honduras
"Mexico"	...	...	Trinidad
"Local No. 2"	...	...	Local
"Long Tom"	...	...	Queensland, Australia
"New Era"	...	...	,, ,,
"2 A. S."	...	...	,, ,,

Onions are making good growth at the Agricultural Station at Whim and tests will be carried out with various manures to hasten maturity, improve keeping qualities, etc. Cauliflowers of exceptionally large size and fine flavour have also been produced there.

Livestock.—The usual routine visits have been paid to the Police Stables and to wharves for the inspection of imported animals, etc. The present distribution of stud bulls in the Colony is as follows :

Georgetown.	—2 Holstein-Friesian bulls at stud
	1 Guernsey Bull do.
	2 Holstein-Friesian bulls which will be ready for service about May.
	2 Holstein-Friesian bulls which will be ready for service about August.
	1 Guernsey bull calf being reared.
Leguan.	—1 Guernsey bull at stud.
Onderneeming.	—1 Holstein-Friesian bull at stud.
Forest Station, Mazaruni.	— do.
West Coast, Berbice.	— do.
East Coast, Demerara.	— do.

An item of more than ordinary interest was the destruction of 22 eight-day old chicks during one night by ants. All the chicks were killed and partially eaten. Specimens of the ants have been identified by the Government Entomologist as *Solenopsis* sp. An inspection of the surrounding areas has been made for nests with a view to extermination of the pest.

Fodder Plants and Grasses.—Analyses of samples of *Paspalum dilatatum*, P. *virgatum*, *Indigofera endecaphylla* and *Phaseolus calcaratus* have been made. Seeds of the following have been sent to the District Commissioner, Rupununi,—Sudan grass, (*Andropogon nodosus*), *Phaseolus semi-erectus*, *Paspalum virgatum*, and *P. dilatatum*. Neem seeds were also sent. *Phaseolus semi-erectus* seed was supplied to the Assistant Conservator of Forests for the Forest station.

School Gardens.—Regular visits are being paid by the agricultural officers to the registered school gardens in the districts and instructions given. Interest by both teachers and scholars continue to be well maintained.

Agricultural Exhibition.—Considerable activity is taking place in connection with the Jubilee Agricultural Exhibition to be held at the Promenade Gardens on April 25 and 26 next and small committees to assist in propaganda work and in the collection of exhibits have been formed in the most important villages in the districts. Catalogues have been distributed and every effort to awaken interest among farmers is being made by the District Officers and Commissioners.

Co-operative Credit Banks.—The Divisional officers have held regular monthly meetings of all societies and the annual audit by the Registrar has commenced.

Beekeeping.—Preparations are in progress for the staging of a Honey Week by the Beekeepers' Association to begin with and to be carried on after the Jubilee Agricultural Exhibition. An attractive programme is being planned. Certain interests in England have been communicated with in connection with the building up of an export honey trade and sample supplies of honey have been forwarded,

General.—At the Botanic Gardens the usual pruning of beds and replanting of herbaceous borders was carried out while the grounds around the head-quarters have been levelled and improved generally. A quantity of seeds of various annuals including several varieties which we do not already possess, were received from Trinidad and are doing well. Two new varieties of Bougainvillaea —" Helen McLean " and " Lady Wilson," also from Trinidad—have been added to the collection.

There has been an increased demand for cacao plants and additional seed-lings are being grown for distribution.

Work on budding and general propagation of citrus plants was continued. Private citrus nurseries started with the help and under the supervision of the Department are making good progress.

THE SECOND MEETING OF THE ADVISORY BOARD OF AGRICULTURE. JANY. 15, 1935

PRESENT.

Director of Agriculture	... ...	*Chairman.*
Deputy Director of Agriculture	... ...	*Vice-Chairman*
Hon. R. E. Brassington Hon. F. J. Seaford Mr. J. F. Martins Mr. R. B. Hunter Mr. S. Andries	... ...	*Members.*

with

Mr. J. F. Irving	... ...	*Secretary.*

Also present were the Hon. E. M. Walcott, Hon. J. I. D'Aguiar, and Mr. L. Evelyn-Moe to whom the Chairman extended a welcome. These gentlemen, he explained, were on the Organising Committee of the proposed Banana Association and which had recently been appointed to consider the subject; he had, therefore, invited them to attend the meeting.

The Minutes of the last meeting which were previously circulated were confirmed.

Before proceeding to the agenda, proofs of a catalogue of the forthcoming Jubilee Agricultural Show to be held in the Promenade Gardens in April, were handed round to members who were asked to make any suggestions they thought necessary after early perusal. The Chairman stated he hoped that all those present would help to make the show a great success.

Pursuant to decisions taken at the last meeting, the Chairman reported that replies had been received from the Director of Agriculture, Trinidad, who had also forwarded a report by Mr. R. O. Williams in connection with trial shipments of Cavendish or Dwarf bananas made to London from that island in 1932. The Secretary of State had also replied to a cable sent him and it was in view of these replies that a meeting had been summoned that day to decide what further action should be taken in connection with the banana industry in this Colony. There were also available some notes from recent literature relating to the Dwarf banana which should prove of interest to members as well as notes on trial shipments of this variety from the Gold Coast.

Mr. Seaford here suggested that Mr. Wortley's letter, which had been previously circulated along with Mr. Williams' report, be read first; this was done and the various points in it were discussed,

The Chairman called attention to the fact that, although discouraging, it must be remembered that Mr. Williams' report was made in 1932 and whilst of value and very helpful, might be considered somewhat out-of-date in view of more recent developments in the carriage, etc. of the fruit. An important point which emerged was that such fruit must reach the market not later than three weeks after being cut, and the Gold Coast experiment had shown that not more than twenty-four hours should elapse between cutting and loading on the steamer.

The cable from the Secretary of State was then read and the various points in it commented upon. It was unanimously decided, according to the information regarding prices and marketing charges supplied by the Secretary of State, that unless the freight charges were considerably reduced, there was little chance of this Colony being able to compete. Provided that the shipping firm reduced its freight from £10 to £7 per ton then it was estimated that the farmer would receive about 25 cents per bunch, out of which packing, transport and handling charges, etc., at this end would have to be met.

The Board agreed that a trial shipment to London as suggested by the Secretary of State should be made, but it was decided that Messrs. J. Lauritzen should be approached in the first place and asked to reduce the freight to £7. If this were agreeable to them, they should be asked to provide steamers to enable two trial shipments, each of 250 bunches of the Dwarf banana, to be made. The fruit might be packed in various ways.

Mr. Brassington stated that he thought that Government would be prepared to waive any port charges in connection with the visit of the ship on these occasions.

Mr. D'Aguiar raised the question of continental markets and it was pointed out that high tariffs were a very serious obstacle.

The Chairman stated that since the last meeting he had dealt with all points that arose in the minutes of that meeting. In connection with the importation of suckers he had taken this matter up with Mr. Thorne of Barbados who had offered to supply a certain quantity, but from a census taken recently it was clear that there was a sufficient amount of planting material of the Dwarf variety available locally. He had also asked the authorities of the Imperial College of Tropical Agriculture for their recommendations and advice in regard to the introduction of these suckers, bearing in mind the crops cultivated here and the danger, if any, from such importation of introducing pests as well. The College authorities shared his view, already expressed, that no importation should be made unless absolutely necessary.

The Board unanimously decided that a cable should be despatched immediately to the Steamship Company stating that it was not possible to offer more than £7 per ton for freight. If export trade is to give even a small return, that sum is the maximum that ruling prices justify. It was also essential that the

firm undertake at least two trial shipments to London, of 250 bunches each, to test results before a definite contract could be entered into. The firm to be asked to reply early giving date the steamers could be expected to call at Georgetown.

It was agreed that Government would have to be approached in regard to provision for expenditure in connection with trial shipments, if these materialized.

Finally, it was also decided that nothing further should be done in regard to planting policy until a reply was received from the Company.

This being all the business the meeting terminated.

NOTES.

Commercial Results from Cane Seedlings.—The Manager of a Berbice estate has kindly supplied the Sugar Experiment Station with the results of some recent comparisons, on a commercial scale, between the standard cane (D. 625) and the varieties P.O.J. 2878, Diamond 10, S.C. 12 (4) and D. 835/18. With his kind permission the results are briefly summarised below, for general information.

P.O.J. 2878 and D. 625.

Plant Canes.

	P.O.J. 2878			D. 625		
Acres.	Sucrose, lbs. per gallon.	Purity.	Sugar per acre, tons.	Sucrose, lbs. per gallon.	Purity.	Sugar per acre, tons.
14.50	1.721	84.7	5.28	1.531	81.0	4.81
10.00	1.500	81.3	3.74	1.420	80.5	4.20
44.00	1.500	81.8	...	1.300	78.0	...
7.75	1.507	81.6	3.78	1.335	78.1	3.95
5.00	1.267	76.8	5.48	1.191	74.9	4.57
8.50	1.345	78.7	4.72	1.290	76.0	4.68
7.00	1.415	80.7	5.01	1.352	77.4	5.41
7.00	1.396	79.4	5.81	1.340	78.4	5.45
7.00	1.468	81.5	5.43	1.361	78.5	5.19
Mean	1.458	80.7	4.91	1.347	78.1	4.78

First Ratoons.

	P.O.J. 2878			D. 625		
Acres.	Sucrose, lbs. per gallon.	Purity.	Sugar per acre, tons.	Sucrose, lbs. per gallon.	Purity.	Sugar per acre, tons.
14.50	1.638	83.6	4.43	1.550	81.5	3.52
2.50	1.670	84.6		1.500	80.00	
Mean	1.654	84.1		1.525	80.7	

P.O.J. 2878 appears to be the heavier yielder of the two canes and certainly has better juice characteristics than D. 625. On this estate P.O.J. 2878 germinates better than Diamond 10 or D. 625 both as a plant and as a ratoon. The Manager reports that it gives bagasse "as good or better than D. 625", and has, so far, given no trouble in the clarifiers or boiling house. Labourers do not like cutting it and it does not load so well in the punts as the other two varieties.

Diamond 10 and D. 625
Plant Canes.

	Diamond 10			D. 625		
Acres.	Sucrose, lbs. per gallon.	Purity.	Sugar per acre, tons.	Sucrose, lbs. per gallon.	Purity	Sugar per acre, tons.
8.75	1.700	86.0	2.92	1.540	82.9	2.30
11.00	1.600	85.0	4.25	1.200	74.0	4.00
18.50	1.530	83.5	3.87	1.208	76.3	3.83
15.50	1.475	81.1	3.13	1.400	80.5	3.85
6.00	1.318	79.2	4.41	1.191	74.9	4.57
7.50	1.424	81.1	4.58	1.378	79.5	5.34
7.00	1.403	80.4	5.03	1.352	77.4	5.41
7.00	1.441	80.5	4.73	1.340	77.4	4.94
Mean	1.486	82.1	4.11	1.326	77.9	4.28

First Ratoons.

	Diamond 10			D. 625		
Acres.	Sucrose, lbs. per gallon.	Purity	Sugar per acre, tons.	Sucrose, lbs. per gallon.	Purity	Sugar per acre tons
8.75	1.70	84.8	4.29	1.67	83.9	3.48
11.00	1.54	81.6	3.40	1.37	79.0	4.00
Mean	1.62	83.2	3.84	1.52	81.4	3.74

Attention should be drawn to the superior purity and sucrose content of Diamond 10 juice. This cane is a good ratooner and more ratoon results are awaited with interest.

Two comparisons were made between S.C. 12 (4) and D. 625 as plants. In one, the Ste. Croix cane gave a higher yield of sugar per acre and in the other a lower yield per acre than did D. 625. Three first ratoon trials were made ; in two S.C. 12 (4) led D. 625 ; in the other, the yields of the two canes were equal. A striking result reported from second ratoons of S.C. 12 (4) is as follows

	S.C. 12 (4)			D. 625.		
Acres.	Sucrose, lbs. per gallon.	Purity.	Sugar per acre, tons.	Sucrose, lbs. per gallon.	Purity.	Sugar per acre, tons.
9	1.620	85.5	4.32	1.524	81.5	3.61

The comparative yields of sugar per acre in these two adjoining nine-acre fields, over three crops, were :—

	S.C. 12 (4)	*D. 625.*
Plants	2.44 tons	3.11 tons
First Ratoons ...	4.00 „	3.83 „
Second „ ...	4.32 „	3.61 „
Total ...	10.76 „	10.55 „

In general, S.C. 12 (4) proved superior to D. 625 in respect of sucrose in juice and juice purity.

D. 835/18 led D. 625 by a wide margin in one plant cane trial and one first ratoon trial. In another plant cane field it proved inferior, by a small margin, to D. 625. In all the cases reported its juice proved superior to that of the standard cane.

From one Demerara estate comes a detailed report on the reaping of 26 acres of P.O.J. 2878 as first ratoons on a heavy, low-lying clay at 10.25 months of age. The plant canes had been reaped in April 1934, after the floods, and yielded 3.04 tons sugar per acre. The general average return from the first ratoons was 3.19 tons sugar per acre. A test run of 110 punts (505.3 tons) was made on the second day after burning, with the following results :—

Fibre per cent. cane :	13.92
Crusher Juice Brix :	17.9
Crusher Juice Sucrose lbs. per gallon : ...	1.65
Crusher Juice Purity :	86.16
Crusher Juice Glucose Ratio :	5.2

Steam Pressure : "at about our normal with usual damper openings."

The milling and boiling-house reports are, on the whole, satisfactory. The Chemist states :—

"Juice worked well and gave no trouble in Triple, Pans, or Curing A "large quantity of this cane could be ground at any time without stressing "Factory other than Presses. Fibre in cane is high ; megass burned well and "yielded a fair amount of surplus megass."

Another Demerara estate reports the following plant cane results from P.O.J. 2878:

Crop.	Acres.	Sucrose, lbs. per gallon.	Purity.	Sugar per acre, tons.	Age, Months.
Spring	9	1.996	90.5	3.44	12.5
Autumn	27	1.604	84.3	4.26	16.0

C. H. B. W.

The Guernsey Breed in British Guiana.—There are few records available regarding the importation of cattle into the Colony, but it is recorded that one Guernsey bull, " Rowland of La Grange," was imported in 1906 and died in 1920, and that two other Guernsey bulls, " Rooseveldt I " and " Rooseveldt II " were in the Colony in 1917.

These bulls were imported from the United States of America, and when in the Colony were stationed at the Botanic Gardens and the Penal Settlement " Rowland of La Grange ", stationed at the Botanic Gardens, gave 628 successful services. It frequently happens to-day that farmers claim that one or other of their better milk cows is of Guernsey breed.

In 1932, the Government imported two young pedigree bulls, " Golden Rex II of the Grove " and " Cardie's Carbine ", and a private breeder imported two young pedigree heifers. These last four importations were from the original home of the breed, the Island of Guernsey, Channel Isles. The young bulls are now well-developed and there is a great demand for their services. The young heifers are cows and, have demonstrated the high butter fat content of their milk.

The following history and detailed description of the breed by the *Royal Guernsey Agricultural and Horticultural Society* will be of interest to dairy cattle owners. For those cattle owners who do not know the breed it is advisable to emphasise those characteristics of the cattle which make them suitable for certain parts of this Colony and unsuitable for others. The Guernsey cow is a dairy animal and is not suitable for those districts where the system of management is ranching. In the home of the breed, all cattle are tethered at pasturage. This custom, practised for many years, has made the animals close grazers, economical feeders and extremely docile. In the Island the cattle are at pasture all the year round. The fact that the cows can be tethered and are extremely

docile makes them most suitable for rice farmers who have no grazing lands but who tether their cattle on small plots of land near their homes or fields. The substitution of cut grass, when the small available grass plots are exhausted, will meet all requirements. Many Guernsey farmers feed only very small quantities of grain, but depend mainly on grass to feed their animals. This is also a common practice of many cattle-owners in this Colony.

The breed matures early and is noted for its longevity. The animals are robust and do not require luxurious stables for shelter; the stables generally provided in the Colony meet the requirements.

The Island of Guernsey is practically free from all infectious bovine diseases. The difficulties of importation are reduced to a minimum because the *Royal Guernsey Agricultural and Horticultural Society* has agreed that any animals for export to this Colony will be selected by the Committees and all arrangements for shipping and other formalities required prior to shipment will be made by them.

T. B.

Botanic Gardens Guide.—It is rather to be wondered that Botanic Gardens of the size and reputation of those in Georgetown should never have possessed a Guide Book or Souvenir of any kind for the benefit of tourists and visitors.

This deficiency has now been made up and a well illustrated Guide with map is now available, and can be purchased at the Gardens' office or at the Tourist Bureau at 1/- per copy.

The Guide and accompanying photographs were prepared and got together by the Department, the bulk of the work falling on the Government Botanist. It was decided to have the printing done in England by a firm experienced in such publications. The arrangements for printing were therefore undertaken by the authorities at Kew, who not only gave us the greatest assistance in revision of proofs, etc., but also checked the nomenclature of all plants mentioned in the Guide, thus ensuring the correct naming of specimens in accordance with the most recent determinations of the workers in their Herbarium.

The general form of the Guide is based on that in use at Kew itself. It is simply worded, plentifully illustrated and should prove welcome to all who visit and are interested in our Botanic Gardens.

J.S.D.

REVIEW.

THE DISEASES AND CURING OF CACAO.

BY

H. R. BRITON-JONES, D.Sc.

The need for a series of handbooks dealing with the diseases of the major tropical crops was mooted at the Imperial Mycological Conference of 1929, and this book by Dr. Briton-Jones has been written as a contribution to the series.

Five chapters comprise the whole, dealing respectively with Root Diseases, Stem Diseases, Pod Diseases, Witches' Broom Disease and the Preparation or 'Curing' of Cacao. Detailed technical descriptions of the fungi referred to have in most cases been avoided, and the book, which contains a number of photographic illustrations of the major diseases, is intended primarily for Planters and Agricultural Officers. A Bibliography is included however, for the benefit of the technical officer and mycologist.

Especial stress is laid upon the economic aspect of disease control, and it is pointed out that a number of the control operations advocated in text books, and in particular spraying, though possibly efficacious as a means of eradicating the causal organism, are quite incompatible with the economic production of the crop. Other standard control measures, such as those recommended for the control of root diseases, are related to a number of factors affecting the environment of the crop, all of which must be taken into consideration when carrying out the operations advocated. As the author states in his preface, the main object to be borne in view is the modification of agricultural practice wherever possible in such a manner as to bring about conditions more suited to the crop and less suited to the parasite attacking it.

The writer deals at some length with the Witches' Broom Disease and the possible means of control. The discussion of the many relevant factors is perhaps a little involved, but the planter should derive from it some useful ideas of methods of defence other than the direct (and expensive) attack on the fungus.

The final chapter on 'curing' describes shortly the methods used in the different cacao growing countries, and discusses the processes of fermentation. The need for further investigation on this subject is made evident. The book is published by MacMillan & Co., Ltd., costs 10/- net, and contains 143 pp. and 37 plates.

E. B. M.

NEWS.

Sir Crawford Douglas-Jones, C.M.G., visited the Headquarters on Wednesday, March 27, and bade good-bye individually to the staff. Most of the staff was known personally by Sir Crawford and very sincere wishes go with him and Lady Douglas-Jones in their retirement from public service in British Guiana. Sir Crawford arrived here in 1926 as Colonial Secretary. During this period he has on several occasions acted as Officer Administering the Government, and, on account of his executive position, has been intimately associated with all measures adopted by Government in relation to agriculture.

His Excellency the Officer Administering the Government has been pleased to appoint a Commission "to enquire into the position which will be created in the Essequibo District if Pln. Hampton Court were abandoned as a sugar estate." The members of the Commission are :—

The Director of Agriculture	...	...	Chairman.
The Director of Public Works Hon. T. T. Smellie, O.B.E., Hon. E. A. Luckhoo Hon. F. J. Seaford Hon. R. V. Evan Wong, B.Sc., G. M. Eccles, Esq., Abdool Rayman, Esq.,	...	...	Members.
with			
The Deputy Director of Agriculture	...	...	Secretary.

The Commission has already begun its sittings and held meetings in Georgetown and Essequibo. Evidence has been given before the Commission by many who have an intimate knowledge of the problems under consideration. It is sincerely to be hoped that, as an outcome of the Commission's findings, recommendations will be evolved leading to some measure of relief for the district.

Messrs. R. R. Follett-Smith, A. deK. Frampton and Major T. Bone, Officers of the Department of Agriculture, accompanied the League of Nations' Commission in connection with the settlement of Assyrians in the Rupununi District and returned to Headquarters on January 18.

Mr. H. Macluskie, Agricultural Superintendent, returned to the Colony from long leave on January 24, and is resident in the Essequibo District.

A Meeting of the B.G. Beekeepers' Association was held on February 4, at the Department's Demonstration and Queen-breeding Apiary. The following is an extract from the Minutes of that Meeting :—

> "Before the meeting terminated, Mr. Borman the President stated that as it was the Annual General meeting and therefore an unusual event, he would like to pay some tribute to the work being done by Professor Dash and his Department for small industries in general and beekeeping in particular. He stated that the small man was now getting better service than at any time previously. On account of the activities of the Department, beekeeping, previously a hobby of a few individuals, had expanded into a promising minor industry, now seeking to obtain a footing even on export markets. As a mark of appreciation to Professor Dash and his Department, the members present unanimously rose to their feet. Professor Dash thanked Mr. Borman and the members of the Association for their kind remarks. He stated that the work being done for the small man was not always easy, nor was the extent of the work being done always appreciated. He had received letters with sentiments very similar to those expressed by Mr. Borman and he was deeply grateful that the work being done was meeting with the approval of those whom his Department was seeking to serve."

The Government Botanist and Mycologist visited the North West District in February to inspect the Experiment Stations at Hosororo and Wauna and report on the various crops under cultivation there. He also visited a number of farms in the district and inspected Mr. Sampson's lime fields and his cultivation on the Barima Road.

Mr. J. F. Williams, who has been working for the last three and a half years in the Chemical Division, has recently been transferred to Berbice. Mr. Williams was educated at Queen's College and studied Sugar Technology at the Imperial College of Tropical Agriculture where he gained his Diploma and Associateship. On leaving the College Mr. Williams accepted a position with Messrs. Booker Bros., McConnell & Co., Ltd. and collaborated with the Chemist-Ecologist in a detailed soil survey of the Sugar estates of the Company. At a later stage he was in charge of the soil work connected with estates of the West Coast of Demerara. In February Mr. Williams was appointed Chemist to the estates of Port Mourant, Rose Hall and Skeldon. The Department wish him every success in his new sphere.

Major T. Bone, Government Veterinary Surgeon, left the Colony on March 2, on vacational leave. Mr. H. A. Fraser, B.V.Sc., has been appointed to act.

Mr. A. deK. Frampton, Agricultural Superintendent, Essequibo, left the Colony on February 26 for the Straits Settlements, where he has been promoted to the post of Agricultural Officer. We congratulate him on his promotion but regret his departure. He proved an efficient officer and a congenial co-worker.

Mr. H. D. Huggins, Agricultural Superintendent, left the Colony on February 26, on two weeks' casual leave of absence, which was spent in Trinidad. Mr. Huggins took the opportunity to collect statistics on the importations of rice into Trinidad, month by month, from India and from British Guiana for the last twelve years.

Dr. J. G. Myers, Biological Control Officer attached to the Imperial College of Tropical Agriculture, arrived in the Colony on March 11. After conferring with the Director of Agriculture, Dr. Myers left on a visit to the North West District to make investigations in regard to parasites of the giant moth-borer of sugar cane (*Castnia licus.*)

Mr. W. G. Delph, who had been transferred temporarily to the District Administration's Office, has resumed his duties as Registrar of Co-operative Credit Banks and, in addition, is responsible for the accounting work of the Department until the resumption of duties of Mr. A. A. Thorne, Accountant, on leave.

Among the recent visitors to the Department of Agriculture's Head Office and adjoining Experiment Stations were Sir Crawford Douglas-Jones, C.M.G., Lady Douglas-Jones, Miss M. Douglas-Jones, Miss P. Dash, Sir Alfred Sherlock, Mr. P. Sherlock, Hon. M. B. G. Austin and party, Mr. A. P. G. Austin, Mr. J. C. Gibson, Colonel L. Galloway, Mr. C. H. Naylor and a party of English schoolboys on an Empire Tour.

The Deputy Director of Agriculture has been on tour in Essequibo, Berbice, East and West Demerara, and on the banks of the Demerara River.

Sir Geoffry Evans, Principal, and Professor R. C. Wood, Professor of Agriculture, arrived with a party of post-graduate students from the Imperial College of Tropical Agriculture on April 1. These visits are paid periodically by students from the College and are welcomed by this Department. The students obtain an insight into the Colony's agricultural industries and problems, and such intercourse cannot but be of advantage to all concerned.

Messrs. L. D. Cleare, Government Entomologist, and R. R. Follett-Smith, Chemist Ecologist, will be proceeding on vacation leave shortly. While in England Mr. Cleare will attend the Fourth Imperial Entomological Conference (to be held in London " in the Summer of 1935 ") and Mr. Follet-Smith, the Third International Congress of Soil Science (to be held in Oxford, July-August, 1935).

PLANT AND SEED IMPORTATION.

The following are recent introductions by the Department of Agriculture.

NAME	QUANTITY	WHENCE SUPPLIED
Economic		
Triploid Hybrid Pineapple	10 crowns	University of Hawaii, Honolulu
Onion Seed— (Red & White Varieties, White Nasik, Red Bombay, Red Globe)	24 ozs.	Agrl. Dept., St. Vincent, B.W.I. do. Montserrat, B.W.I. Agrl. College, Poona, India.
Cassava— (Bacuit & White)	10 cuttings each	Manila, Philippine Islands
Padi—9 Varieties	5½ lbs.	North Borneo & India.
Vegetable seed (asstd.)	4 lbs.	Messrs. Sutton & Sons, England.
Tobacco— (Yellow Mammoth, Kentucky One Sucker, Hickoy Pryor, Comstock Spanish)	7 packets	Imp. College of Tropical Agr., T'dad. U.S Dept. of Agric. (through Messrs. W. H. Knox, U.S.A.)
Passiflora spp.	3 do.	Dr. Wm. A. Archer (U.S.D.A.) Paramarbio, Suriname.
Rattlesnake Watermelon	1 do.	St. Clair Expt. Stn., Trinidad
Beans— (Madagascar, Danubin, Ohtenashi)	3 do.	do,
Papaw— (Mexico, Special A.S. type, New Era type, Long Tom)	small quantities	St. Clair Expt. Stn., Trinidad Queensland Acclimatisation Society, Queensland, Australia.
Sesbania speciosa Taub.	4 ozs.	Royal Botanic Gardens, Kew, England.
Rice Bean (*Phaseolus calcaratus*)	2 lbs.	Agrl. Dept., New South Wales, Australia.
Reana Luxurians— (*Euchlaerna Luxuriana* " Teosinte")	1 lb.	Messrs. Sutton & Sons, England.
Nutmeg Seeds	460 seeds	Agrl. Dept.. St. Vincent, B.W.I.
Aleurites montana	30 „	Queensland Acc. Soc., Australia
Aleurites montana	175 seeds & 1 Fruit	La Ceiba, Honduras
Aleurites Fordii	30 seeds	Queensland Acc. Soc., Australia
Macadamia ternifolia	24 seeds	do.
Pecan nut (*Carya olivae-formis*)	12 seeds	do.
Santo Domingo Mahogany	1 Fruit	La Ceiba, Honduras
Ornamental		
Trachycarpa excelsa	3 plants	Coconut Grove Palmetum, Florida, U.S.A.
Bignonia venusta	2 plants	St. Augustine Nursery, Agric. Dept., Trinidad, B.W.I.
Bougainvillaea— (" Helen McLean ")	6 do.	do.
Orchids—6 varieties	9 do.	Heneratgoda Bot. Gdns., Ceylon.

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the agricultural and forest products of the Colony exported during 1934.

The corresponding figures for the same period during previous years and the average for the 25 years prior to that are added for convenience of comparison.

Product		*Average 1907-31*	*1932*	*1933*	*1934*
Sugar	tons	105,893	137,078	127,083	129,913
Rum	proof gallons	1,177,059	645,511	883,019	1,120,090
Molasses	gallons	3,043,187	7,554,520	8,137,233	5,384,834
Molascuit	tons	1,481	205	178	nil
Rice	tons	14,167	28,541	29,120	14,700
Coconuts	thousands	843	962	1,748	2,487
Coconut Oil	gallons	23,028	19,048	19,962	12,662
Copra	cwts.	39,085	15,140	18,420	14,000
Coffee	cwts.	5,790	9,414	1,020	6,166
Lime Juice Concentrated	gallons	8,691	958	nil	10,468
Essential Oil of Limes	gallons	486	730	1,166	892
Rubber	cwts.	139	nil	nil	nil
Balata	cwts.	7,063	5,699	4,281	2,219
Gums	lbs.	1,280	1,484	nil	nil
Firewood—Wallaba, etc.	tons	9,810	13,219	13,796	14,566
Charcoal	tons	2,733	3,770	3,268	3,390
Railway sleepers	No.	11,579	13,695	11,501	19,966
Shingles	thousands	1,759	1,283	881	760
Lumber	ft.	201,040	142,429	163,083	141,214
Timber	cu. ft.	236,442	178,237	184,489	185,413
Cattle	head	521	447	458	916
Hides	No.	6,280	4,987	5,110	6,528
Pigs	No.	563	431	413	973
Sheep	No.	12	27	2	3

WETTEST AND HOTTEST DAYS AT VARIOUS STATIONS.

Stations	Wettest Days	Rainfall, Inches	Hottest Days	Temperature in shade
Botanic Gardens, Georgetown	7th Jan.	7.16	18th, 27th August 18th, 19th Sept. 1st October	89.0° F
New Amsterdam, Public Gardens	8th Jan.	4.50	16th, 18th June	96.0° F
Onderneeming, Essequibo	3rd Jan.	3.20	19th Sept. 7th October	92.0° F
Hosororo, N.W.D.	14th Nov.	2.95	20th August	94.5° F

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CONTENTS.

(Vol. VI, Nos. 2 & 3.)

LIST OF ILLUSTRATIONS.

The
Agricultural Journal of British Guiana.
June—Sept., 1935.

EDITORIAL.

AGRICULTURAL HERITAGE.

In life in general and in agriculture in particular there is many an heritage which the father hands down to the children, yea, even unto the third and fourth generation. If our heritage be good we enjoy the benefits, if bad we pay the penalty. This is the law, written and unwritten.

We may instance as an heritage for which the succeeding generation pays the penalty, the present economic situation. Whatever differences of opinion there may be as to the fundamental reasons for the partial collapse of the industrial, commercial, and social structure, in regard to the immediate cause there is universal agreement. During the Great War, prices of products—whether of sugar, wheat, coal, or diamonds—soared and remained high for some years afterwards. During this period bounteous profits were made, wages advanced and prosperity was no longer around the corner but confronted one boldly and immodestly. High commitments in business, expensive tastes in private life came to be regarded not only as excusable but essential; that generation adopted the new philosophy with energy and there is no reason to believe that we of today would have done otherwise. Conditions have changed, prices have fallen and interest charges are being paid on the high commitments then made out of the low profits now collected. The man who embarked on family life then had every inducement to plan for himself and his family an ambitious programme. Today an older and a saner man, he finds that to ensure a living wage for himself is not easy and to secure employment for the family which he now has raised even less easy. At the present time, most of the failure and disappointment in agriculture and in business are due not so much to the inability of the agriculturist or the businessman as to the fact that he was born at an unfortunate time; this depression is the harvest in which those reap who did not sow.

On the other hand, let us hope that we of this generation have not become so obsessed with these dreary thoughts as to be unmindful of those kindlier

heritages which this and other agricultural communities have reason to be thankful for. We inherit today health conditions such as those before did not enjoy, and the improvement that has occurred is based on knowledge gained from those who have suffered before and handed to us the benefits of their experience. British Guiana's public health statistics testify to the improved health conditions in the rural districts, and the modern type of cottage on the Colony's sugar estates is an indication of the better living conditions of an important section of our agricultural population. Nor must we, in fairness to those times when high prices ruled, omit to acknowledge that we today still enjoy the benefits from improvements which then were made in field and factory, in sea defences and equipment.

In the case of the agriculturist, the heritage which must receive first thought is the farm business which he inherits. The age has passed when farming was regarded mainly as a mystic art to be practised successfully only if the farmer possessed certain indefinite and intangible qualities which made him what was termed a "good farmer". Today it is recognised that there are certain very definable and tangible factors which control "good farming". Considerations which we have in mind are those such as size of business, rates of production, combination of enterprises; affecting all these is the quality of soil on which agricultural production is attempted and, in this Colony particularly, facilities for drainage and irrigation. Then, since a large percentage of the agricultural community inherits its business as a going concern, it follows that the foresight and planning of the father materially affect the well-being of the son; the following quotation from Jared Van Wagenen, writing about farms established on poor soils, gives expression to this view :—

> "Most of us will remember the story of how the author of "Pilgrim's Progress on seeing a man being carried in a cart to die on the "gallows fervently exclaimed, "But for the Grace of God—there goes "John Bunyan." It is an old story that for me never loses its appealing "force. Even so I am tempted to paraphrase it by remarking that only "by a narrow chance did I escape being a hill farmer. If my great-"grandfather, Jared, trekking along the trail of the Lunenburg Pike in "July of the year 1800 had halted his ox team a few miles further east, "then I suppose I would have belonged to the class of whom I write, "but fortunately for me and for my children he was not moved to say "'Whoa,' until he came to a limestone valley lying in the lap of the "hills. But I suppose this happy fortune was by accident or Providence "rather than any particular knowledge or design upon the part of my "great-grandfather."

In addition to the business and farming ability of the individual, other economic factors play a far-reaching part in the progress which he makes and, as a necessary consequence, in the heritage which he passes on. In general, India is

a country of peasant cultivation and small holdings. In Northern India, over which the Moghul dynasty in ancient times held its firmest sway, has been evolved the *zamindar* system where friction between tenant and landlord (*zamindar*) has continued to create a problem of importance. In other parts of India where this heritage from Moghul rule is not so much in evidence the peasant obtains his land direct from the State (with the elimination of the *zamindar* or landlord); in those latter areas, where the *ryotwari* system prevails, the problems are somewhat different and are largely connected with the sub-division of holdings into uneconomic units, the rules controlling inheritance being largely dictated by religious rites. The plantation system could be easily developed only in those areas not densely populated (tea plantations in Assam and Darjeeling, coffee and rubber plantations in Southern India).

In the West Indies and British Guiana evolution has taken place along different lines. European occupation in the Caribbean took place for the purpose of productive agriculture, while in the East, trade was the main objective and occupation followed incidentally mainly for the purpose of protecting trade. During the occupation of the Caribbean the indigenous population received short shrift and was, at any rate in an economic sense, practically eliminated. Ecological conditions made the Caribbean a very suitable source of tobacco, cacao, sugar and cotton. Plantations grew up and, in the absence of a local supply, labour had to be obtained from external sources—first by slavery from Africa and later by indenture from India. On the abolition of slavery, the freed slaves in many cases settled on Crown Lands in the vicinity of plantations as did the East Indians on the termination of their contracts; in consequence, a feature of the Caribbean agriculture is the harmonious co-ordination of plantation and peasant agriculture.

We have quoted these instances merely to show how important a part is played in the progress and lines of development of an agricultural community by its heritage. Nor are other instances lacking. There could be mentioned Ceylon with its early Portuguese and Dutch occupation leading to the monopolistic control of the production of spices and areca nut, with the payment by tenants by service and later the abolition of service tenure, the regulations forbidding the tenure of lands by Europeans until well into the nineteenth century; Mauritius with an historical background similar in many ways to that of the West Indies; Kenya with its attractive climate; Gambia with its limited potentialities as a source of natural produce.

We shall close this discussion, which has been general in its application, with reference to two specific circumstances. British Guiana is pre-eminently an agricultural country. A problem which has arisen in many other countries is being sensed locally: not a high enough percentage of farmers' sons is returning to the farm as a first resort. It has been found in every country, where this problem has been studied, that a higher percentage of sons of successful farmers

return to the land than of less successful farmers. The moral is that, if the children are to return to the land, the fathers must have made a successful living from the land. State assistance and guidance, therefore, must be directed primarily to those already on the land since if the prospects be poor no amount of agricultural education will force the youth of the country back to the fields.

The second and last circumstance to which we shall make reference is the agricultural legacy which we of this generation in British Guiana shall hand down to our successors. Sugar and rice are the two most important industries of the Colony. Either in spite, or because, of the unfavourable market conditions which have for some time prevailed, the sugar yield for the first time in the history of the Colony has reached approximately three tons per acre. This is about 50 per cent. higher than the average yield for the period 1925—1928. The rice yield has increased with the use of improved seed by 2 to 8 bags of padi per acre and the standard of the marketed product, both in quality and uniformity, has improved appreciably. It is obvious what advantages will accrue from these improvements when the price structure at some future date regains its equilibrium. For the good of our country and of our children, let us hope that each heritage which we shall bequeath will bestow as much credit on ourselves and benefit on them as must this phase of our agricultural achievement.

THOMAS MILLARD, C.M.G.

The death of Honourable T. Millard, C.M.G., Colonial Treasurer and acting Colonial Secretary, occurred at his residence, Georgetown, British Guiana, on May 25, 1935. During his six years' service in the Colony, Mr. Millard had on occasions acted as Colonial Secretary and as such it fell to his duty to discuss matters of agricultural import. In this connection his contributions always gave those indications of clear thinking and impartial, logical deduction typical of his service to the Colony. He maintained especial interest in the work of this Department and was always anxious to support it by every means in his power. The agricultural community in common with every other section of the population mourns his loss.

JUBILEE AGRICULTURAL EXHIBITION, 1935.

In 1933, the question of holding a Colony wide exhibition, both industrial and agricultural, was mooted, and the then Governor was anxious that such an exhibition be held. A general committee, of which the Director of Agriculture was Chairman, was appointed to consider the whole matter, including ways and means. On account of the high estimated cost of this undertaking and a series of untoward incidents culminating in the 1933-34 floods, the project was indefinitely postponed. Late in 1934, when the question of Jubilee celebrations was being discussed, the Director of Agriculture submitted the proposal that a purely agricultural exhibition be held and that the expenses be met from his Departmental vote with some additional financial help. From this beginning sprang the *1935 Jubilee Agricultural Exhibition*; widespread Colony organisation plans were initiated; propaganda work was undertaken by the Department in every district; the Exhibition was opened by His Excellency the Governor at 3 p.m. on Thursday, April 25. The Show lasted for two days: approximately 4,000 exhibits were submitted and about 5,000 visitors attended. By popular acclaim, this was one of the most successful exhibitions staged in the history of British Guiana.

The Exhibition was held in the Promenade Gardens, Georgetown, and as no permanent buildings were available, exhibits were housed in several temporarily erected stands. The building that was most original in design and attracted universal comment was the Sugar Stand (See Pl. xix, Figs. 1 and 2). The entire framework was faced with sugar canes and on the peak of the roof the words "LONG, LONG LIVE THE KING" were formed with canes of different colours High over the stand flew the Union Jack, a long cane forming the flagstaff. In this stand were samples of different kinds of sugars, fertilizers and all the principal varieties of cane known in the Colony. In addition, there were graphs showing the percentage of the total exports of the Colony contributed by sugar and its by-products, the effect of sulphate of ammonia on cane, the effect of flood-fallowing, the yields of sugar per acre, etc. The last mentioned graph was arresting, in that it showed how the Colony's production had consistently increased within recent years athough the area under cultivation had not expanded.

The Department of Agriculture's stand (See Pl. xix, Fig. 3) was mainly instructional in nature. The several divisions endeavoured to display, in a popular and readily understandable manner, the work with which they

were concerned. Thus, the Entomological Division displayed placards depicting the chief pests of the Colony and methods of control. The Rice Breeding Station showed the principal varieties of rice in the Colony and the distribution of Pure Line areas in the districts together with a simple representation of Mendelian principles as applied to rice. The Chemical Division indicated the effect of certain fertilisers and soil reactions. The Botanical Division exhibited plants of horticultural and economic importance. The Livestock Division showed fodder plants and some of the important intestinal parasites of domestic animals. The Beekeeping Division showed the chief appliances used by the modern beekeeper together with a glass hive complete with bees. The Economic Division displayed diagrams bearing on agricultural credit, cost of living, fluctuations in prices and the competition of Indian and British Guiana rice on the West Indian Market.

There were a number of other stands in which were placed articles for competition. Thus, two large stands housed livestock, including pure-bred Holstein-Friesian (See Pl. xxi, Fig. 5) and Guernsey stock, donkeys, goats, pigs, and poultry. In another were housed rice, milled and unmilled, coconuts and its by-products, coffee, and honey and its by-products (See Pl. xix, Fig. 2); in another were provision crops, including plantains, cassava, yams, tannias, etc.; in another were vegetable crops, including tomatoes, onions, cucumbers, cabbages, eschallots, peas, and beans ; in another were the fruit and horticultural exhibits (See Pl. xix, Fig. 4) and in another were the home manufacture exhibits, *e.g.*, starches, preserves, wines, etc. ; and certain miscellaneous crops.

The Department also let space to individuals or firms for the advertising of articles related to agricultural industries. Of these, one of the most attractive was the stand erected by the British Guiana Beekeepers' Association displaying a large quantity of Colony honey in uniform honey jars bearing standardised labels (See Pl. xix, Fig 5). Other stands which attracted attention were those displaying the agricultural machinery sold by Messrs. Booker Bros. Hardware Department, the products locally manufactured by Messrs. Booker Bros. Drug Stores, the advertising booths by the Sun Life Assurance Co., and by Ovaltine manufacturers. The stand exhibiting locally produced agricultural articles, *e.g.*, copra, rice, etc., and designated "HOPE PRODUCTS", was also interesting.

The remarkable success achieved by this Exhibition bears testimony to the value of the educational work of the Department of Agriculture in the rural areas of the Colony during recent years.

Fortunately, perfect weather prevailed throughout, and the magnificent effort made by all sections of the agricultural community was well rewarded by the success attained.

SPEECH BY DIRECTOR OF AGRICULTURE.

Professor Dash said: " Your Excellency, Mrs. Northcote, Ladies and Gentlemen, it is my pleasant duty and a privilege to welcome Your Excellency and Mrs. Northcote to this the first Exhibition of its kind which has taken place in the Colony for many years. We all know that this is a very busy and anxious period and the calls on Your Excellency's time are numerous. Nevertheless, Sir, you have found it possible to be present this afternoon and I should add that Your Excellency has evinced a great deal of personal interest in the Exhibition and has also made a substantial contribution to the funds. Agriculturists are indeed grateful for this early and tangible proof of your interest in their welfare.

Now, Sir, the history of exhibitions in this Colony does not make enthusiastic reading. By this it is not suggested that enthusiasm has always been lacking, but the difficulties of finance and organisation have been and are great drawbacks. My early impression, too, of such District Agricultural Shows as were held at one time was that, among other things, standards of quality were absent and that much practical education would have to be done before any great success was likely to be achieved in connection with Shows. To that end the Department, since reorganisation, has concentrated on field instruction, demonstrations and competitions in order to raise, in the first place, the standard of production. I believe and I think those present will agree, after seeing the exhibits, that at any rate a measure of success has been achieved in that direction, and my district officers have done splendid work in spite of great handicaps and much uninformed criticism. Another important factor contributing to the success of the Exhibition, certainly as regards the number of exhibits, has been the free transport facilities provided by the Transport and Harbours Department. I may say that there are approximately 4,000 entries and it is an undertaking to get such exhibits to Georgetown from outlying parts of the Colony. Thirdly, the Exhibition has been associated with the Jubilee Celebrations of His Majesty the King and the people of this Colony are second to none in their loyalty to the throne. Lastly, but by no means the least, there has been the desire on the part of our farmers to show Your Excellency that—in spite of inherent difficulties on the coastlands—given favourable weather, they can produce commodities of good quality and in quantity; that they are proud of their calling and are capable of response to any interest taken in their welfare.

I should like for a moment to say something of the background of the present venture. In 1933, the question of holding a large Exhibition, both industrial and agricultrial was mooted, and Sir Edward Denham was anxious that such an Exhibition should be held. A general Committee, of which I was Chairman, was appointed to consider the whole matter including ways and means. A number of sub-committees collaborated in the work of estimating and getting out

prize lists. It was found that a sum approximating $10,000 was the least which a large Exhibition would cost, bearing in mind the lack of facilities here for housing such a show. On the revenue side, it was difficult to see how such an Exhibition could be self-supporting and, finally, the whole scheme fell down on the score of finance. I then offered to run a small Agricultural Exhibition from my own departmental vote coupled with such financial contributions as might be collected from local firms and others interested. In this connection, I am grateful for the assistance so far received, but our lists are still open and as we shall need all we can get to avoid a deficit, I trust that those who may have guilty consciences will not think it too late to come forward. The present effort then was scheduled for 1934 but had to be postponed on account of the floods, followed by drought. When the subject again came up towards the end of last year it was nearly abandoned once more on the score of finance as a balance on the wrong side seemed inevitable, especially if the weather proved unfavourable. Well, Sir, I was determined on this occasion, come what may, an Agricultural Exhibition was going to be held this year, and I am very grateful personally to Your Excellency for the encouragement you have given me, and to the Board of Agriculture for their support and co-operation. I would further like to take this opportunity of thanking those who have assisted in the districts and others who have collaborated with us during the last few days in arranging the exhibits, including the receiving committees, secretaries and judges, all of whom have worked hard and late to enable the show to be opened to-day ; also the Inspector-General of Police for the use of the Band, the Transport and Harbours Department, the Editors of the newspapers, and last but not least, the Mayor and Town Council for the loan of the ground.

It would be invidious for me to single out for mention any exhibits as they are so many of outstanding merit. I would like specially, however, to invite your attention to the Sugar Section. The display has taken a novel form—I will not describe it to you—and depicts graphically both the importance of the industry and the results obtained from the research of the Department and the Sugar Experiment Station in recent years. Equally, Demerara rice will whet your appetite either with coconut (in a curry), with peas and beans, or with honey supplied by the Beekeepers' Association whose stand adjoins the Department's general demonstration booth. All of these you must visit. Finally, should you be overcome with fear of the animals you can secure a life policy with the Sun Life Assurance Company which is also nearby. I thank you for your presence this afternoon and hope you will feel rewarded for coming.

At a later stage, certain announcements will be made both in regard to the Cups before us which Mrs. Northcote has kindly consented to present to the winners to-day, and the Diplomas of Merit. I now have much pleasure in asking Your Excellency to declare the Jubilee Agricultural Exhibition open."

OPENING OF EXHIBITION BY HIS EXCELLENCY THE GOVERNOR.

In declaring the Exhibition open His Excellency said: "Ladies and Gentlemen, it affords me a great deal of happiness that my first public function, since I took the Oaths of Office of Governor, is staged in a setting which enables me to carry on the train of thought which occupied my mind at the first moment. I spoke then of the necessity of continuing and enlarging the development of this Colony's assets, and here to-day it is my pleasant duty to open formally a Show which is designed to exhibit—and, as I know from a preliminary cursory inspection, does exhibit—some of British Guiana's opportunities and abilities for making a wider and better use of her soils.

The value and importance of Agricultural Shows to good and scientific farming and the production of the fruits of the earth cannot easily be exaggerated. It is a common saying that any fool will make a farmer, but it is really a poor kind of fool who thinks so. Of course it is true that seed or suckers or sugar-canes will grow of themselves and without the aid of man but, as everyone knows, the mere making things grow is the least part of the farmer's task. The farmer, like every producer, is concerned to produce not a mere 'something' but the best 'something' of its kind, not just a crop but a crop that is good enough to find a sale in a highly competitive market.

We, in British Guiana, know only too well what competition in agricultural markets means and how hard is the fight, which our planters and farmers have, in order to keep their heads above water. We know from bitter experience that the secret of survival, to say nothing of success in such circumstances, is concentration upon and achievement of quality: and when I say that, I mean quality not only in the product itself but also in the marketing of that product.

I want to take the opportunity which this Show offers of stressing the immense importance of quality to the agriculturist on both aspects of his industry, that is to say the growing and the selling aspects: for however ingenious and water-tight may be the defences of quotas and tariff protection, they can be of no ultimate avail unless they defend really high quality stuff. Equally they will be ineffective unless that good stuff is efficiently put on the market. The old saying that 'good wine needs no bush' may be true even to-day of wine, though I doubt it; it is utterly untrue of the humbler necessities of life such as sugar and rice.

At an Agricultural Show, of course, it is principally quality in production which gains notice and approbation. There on stalls lie specimens of the best which the country can produce or rather—and the difference is not unimportant —the best that it has produced up to date: there is always room for hope of im-

provement. The eye can gauge the size, shape, and colour of the exhibits, and the hand can judge of texture and so forth : or at any rate would if the touching of exhibits were allowed. The educative value of Agricultural Shows is proved by that alone, for by means of those ancient instruments, the eye and the hand, mankind learns more easily than he does by brain-work and study. Moreover, "seeing is believing", as the saying is, so that one of the incentives for farmers which such a Show creates is that of faith in himself and his ability to achieve success, without which support he would grow nothing ; while another stimulus engendered by Shows is that of rivalry—friendly rivalry, of course—and there is no stronger urge to human nature. The sensible man does not waste time envying his neighbour, he tries to outdo him ; and so it is that the round world progresses.

There is another effect—and a highly important one—which Agricultural Shows can produce, and in my opinion, this particular Show does produce, and that is that it enables the general public, not exclusive of the farmers themselves, to realise through the medium of their eyes, something—though only a little bit, I fear—of what their Agricultural Department is doing. An Agricultural Department is usually the target of many shafts. Most people know, or believe that they know, a good deal about the subject of agriculture and they feel, therefore, that they are competent to criticise the efforts of the Director and his minions. Now, I have not a word to say against criticism; personally, I welcome it, especially if it is constructive in nature ; and speaking from personal experience I can say that without enlightened and intelligent criticism a public servant works in the dark and is hampered accordingly. Nor am I for a moment implying that past comments on the performance and success of our Agricultural Department have fallen below that high standard—I do not know nor care whether they have or have not ; I am speaking of criticism in general and I feel quite sure that my friend Professor Dash agrees fully with my generalities on the subject. The point which I am aiming at making is that, at an Agricultural Show, an Agricultural Department has an opportunity of displaying before the public gaze some visible and tangible evidence of the outcome of its endeavours and thereby giving the best of all answers to its critics.

After all, if Agricultural Scientists have to improve on Nature—what a horrible phrase !—they must work along the lines on which Nature has improved herself. Everyone knows how infinitely slowly such progress has moved ; the pace of evolution is immeasurably gradual. Well, one does expect the Scientist to move a bit more quickly than that, but, for all that, it is only natural that his experiments and investigations should consume a great deal of time ; and perhaps it is equally natural that the layman should become a little impatient. Here, at a Show such as this, there comes the chance of a reconciliation of ideas on the subject ; and I venture to predict that the stalls which display the work of the 'ologists are going to prove at least as attractive as any of those which boast more material wares. Frankly, ladies and gentlemen, I believe that when you have

seen what I have had a private peep at this morning you will all want to give Professor Dash and his hardworking staff a very special pat on the back. It is unfortunate that the Show cannot exhibit to an equal degree the value of the Department on the marketing side of which I spoke just now, but Shows are not adapted to that end. Nevertheless the strenuous efforts which the Department has made in that direction are not unknown to you.

I do not want to detain you too long, for you are very naturally and rightly longing to get to the Show itself and to see what it contains. But before I declare the Show open I must fulfil one or two other pleasant duties. In the first place I have to thank all those who by contributions and the gifts of prizes have helped to promote the Show; and I must make honourable mention of the great generosity of Barclay's Bank and the Royal Bank of Canada for the very handsome cups which they have presented; such practical assistance is most encouraging. Secondly, I should congratulate the exhibitors, especially the winning ones, on their energy and skill; it is greatly to be hoped that subsequent Shows will display exhibits not only from them but also from many other producers stimulated by the fine example of those who came forward on this first occasion.

Thirdly, a word of the highest appreciation is due to all those who have worked so hard and so successfully to organise this first Agricultural Show of British Guiana. A vast deal of credit is due to the unseen work put in over many months by the Divisional Agricultural Officers in disseminating propaganda, overcoming apathy and inferiority complexes, and, when stimulation had done its work, collecting and ensuring delivery of exhibits. Then there are those who planned and carried into effect the layout and the detail of the Show, and lastly, behind all these is the generative impluse supplied by the Director and the Board of Agriculture. In respect of all these hard-working and public-spirited gentlemen, I take it upon myself on your behalf to acknowledge, and to praise, and to express gratitude for their unremitting labours, and to congratulate them most heartily on their splendid results.

I will now exercise my privilege and declare open the first Agricultural Show held in British Guiana in modern times.

PRESENTATION OF PRIZES.

The Director of Agriculture next announced that the Banks had left it to him to decide the purposes for which the two Cups on display should be awarded; and after consideration he had decided not to award them for any specific exhibits on show, but rather for some work or enterprise which had helped the Colony and the Department. He therefore proposed to award one Cup to the Rice In-

dustry and the other to the Sugar Industry. He mentioned rice first, not because it was the leading industry but because it showed how important it had become.

The Cup from Barclay's Bank would be presented to the Hon. E. M. Walcott for the splendid work and assistance he had given to the pure line seed padi scheme of the Department of Agriculture. About two years ago Mr. Walcott had something like 900 acres of the most beautiful pure line padi under cultivation and at present he had about 700 or 800 acres. That was an example which all other proprietors should follow, as the encouragement of pure line padi resulted in much benefit to the tenants. Mr. Walcott obtained about 33 per cent. more yield from pure line on his estate where returns of 40 to 47 bags of padi per acre, depending on the nature of the land, were quite frequent.

With respect to the Cup presented by the Royal Bank of Canada, he proposed to award it to the most successful cane-farmer in the Colony. The Department had been endeavouring for some years to impress local agriculturists with the desirability of pushing and extending cane-farming. Notable efforts were being made at Buxton and Beterverwagting and also at Rose Hall Village, Corentyne. After a careful survey by the Department, he had decided that the farmer to whom the Cup should be awarded was Mr. James Marshall of Buxton, who had been engaged in cane-farming nearly all his life and in mixed farming as well. Mr. Marshall had ten acres under cane at present, and the runner-up was Mr. Robert Williams of Rose Hall, Corentyne, to whom a money prize would be awarded by way of encouragement. Lady Northcote then presented the Cups to the winners.

On receiving his cup, Mr. Marshall said he was pleased to have won it, and confessed that he wanted to give up cane-farming some time ago, but "the Professor stick behin' me."

Mr. Walcott said he would not buy a new hat the next day because he had won the cup. He attributed the success achieved entirely to the Department of Agriculture and its officers. It was only they—the farmers and himself—who could appreciate the good work the Department had done and he had no hesitation in saying that during recent years the Department had been endeavouring to place agriculture on a sound footing in British Guiana. If they had not benefited from the efforts and advice of the Department he was afraid it was their own fault. As they all knew it was only hard work and co-operation that could give birth to the twins of success and prosperity.

Subsequently the following have been awarded Diplomas of Merit signed by His Excellency the Governor and the Director of Agriculture for outstanding exhibits:

Rash Beharry & Co., Essequibo, for Whole Grain Super Rice packed for Export,

Mr. J. Taylor, Lodge Village, for Holstein-Friesian Grade Heifer.

Mr. E. M. Walcott, Pln. Hope, for Coconuts in Shell.

Mr. E. Chan-a-Sue, North West District, for Liberian Coffee.

Buxton Wesleyan School, for Blackeye Peas.

Whim School, for Onions.

Mrs. Ethel Bourne, for Guava products.

The Carnegie Trade Centre for Women, for mixed preserves.

Mr. K. C. Bose, Triumph, for homemade bee appliances.

EXHIBITION VIEWS.

Fig. 1 :—The Sugar stand. The structure was completely faced with canes —including the panels with mosaic-like patterns. The words "LONG, LONG LIVE THE KING" were constructed with cane and even the flagstaff was formed by a long erect cane. At the entrance, the word "SUGAR" was formed with white lump sugar. In the windows of the building were several material graphs depicting the relationships of various factors connected with the industry. In the foreground, in front of the building, are bundles of farmers' canes entered for competition. In the door-way of the stand, from left to right—Mr. C. H. B. Williams, Agronomist, Mr. C. Cameron, Field Manager and Mr. C. L. C. Bourne, Secretary, Sugar Experiment Stations.

Fig. 2 :—There are seen, in the right foreground, a section of the Home Manufactures stand, in the middle foreground the Rice and Coconuts stand and in the background the Sugar stand. To the left is a group of school-children who are being conducted over the grounds and having matters of interest explained by Agricultural Officers.

Fig. 3 :—The Department of Agriculture's Educational Stand with the Director of Agriculture at the entrance. Full particulars of this stand, which housed exhibits and illustrations of the work being done by the various divisions of the Department are given on pages 61 and 62.

Fig. 4 :—There are, at the left, the truck vegetables and General Horticultural stand; at the right, the Livestock stand. A group of school children can be seen studying the animals, among which were some excellent examples of imported and locally reared pure-bred Holsteins and Holstein-Creole crosses.

Fig. 5 :—The British Guiana Beekeepers' Association Booth. In this stand, honey was exhibited in mass effect and is seen arranged on shelves in tier-like formation. The uniformly high grade of honey, the standardised jars and the attractively coloured Association Label served to make an exhibit well worthy of the effort. In the foreground are bees' wax replicas of the three Pyramids of Gizeh, moulded to scale with great patience and accuracy by one of the members of the Association. From this booth were obtained many orders for honey.

FIG. 1.

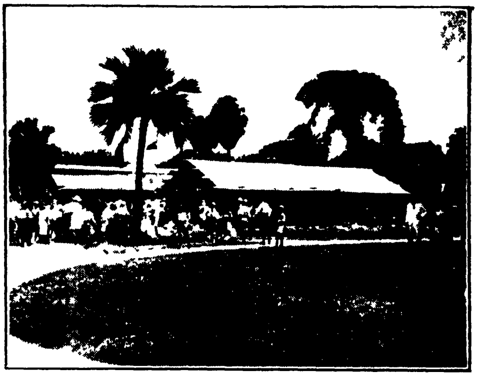

FIG. 2.

FIG. 3.

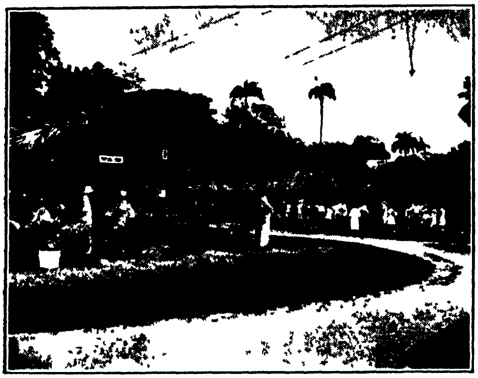

FIG. 4.

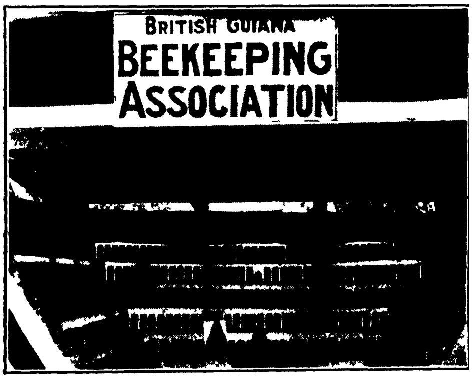

FIG. 5.

PLATE XX.

FIG. 1. Holstein-Freisian Bull "BILL" (Creole born.) Age 3 yrs.
Sire—Texas Wonder; *Dam*—MISS Rose (Both imported.)

ORIGINAL ARTICLES.

DAIRY CATTLE IN BRITISH GUIANA

BY

H. A. FRASER, B.V.SC.,

Government Veterinary Surgeon (Ag.)

Milk is the most valuable of all articles of diet for Man. It is the natural food of the young to build up muscle and bone, and for the repair of tissue in the adult. It should therefore be produced under clean and sanitary conditions to ensure a healthy and well developed population.

In this Colony the production is mostly in the hands of the peasantry, chiefly East Indians, and it is the policy of the Department of Agriculture to keep pure bred dairy bulls at their Stock Farm and centres to improve and increase the milk producing qualities of the native stock.

The foundation stock of cattle on the Coastlands is a mixture of the better known British dairy and beef breeds and the Indian or Zebu breed. These have bred and inbred at will on the pastures of the Colony without any process of selection or segregation. After many generations a type has evolved that is exceedingly hardy, immune to tick-borne diseases, and adapted to the semi-aquatic mode of life obtaining on the low lying pastures which are difficult to drain in the heavy rainy season.

This type of animal known as the Creole or native cattle, exhibits marked variation in characters in certain districts. They are used for work, as milchers, and finally for beef.

There are two systems under which milk is produced :—

1. The Pen System
2. The All-year grazing System.

The pen system of milk production is semi-intensive in character, and obtains in areas which are in close proximity to the centre of consumption. An average number of about 10 head are kept in byres approved by the Public Health Department under clean and sanitary conditions. The animals are fed on grass cut chiefly from estate and village backlands, the parapets of roads, etc., together with concentrates (consisting of linseed oil meal and broken rice in the form of a wet mash). The yield of milk is from 8 to 14 pints daily.

The all-year grazing system occurs in areas further removed from the towns and villages, and in close proximity to large grazing areas. The size of

the herd may be from 20 to 100 animals, and they graze on the pasture all the year round. The cows are milked once per day and yield 2 to 4 pints each. The calves are allowed to suckle their mothers and obtain the first milk which is poor in fat, and the strippings which are the richest. The result is that they are usually pot-bellied and unthrifty due to digestive troubles, and develop into poor animals. Under this latter system, the milk sold to consumers is not of the best quality and is also heavily contaminated from the unwashed udders of the cows and other foreign matter. The greater part of the Colony's milk supply is obtained from this source, therefore the need for improvement of dairy cattle and methods is apparent.

In 1928 when the Department of Agriculture was re-organised, a definite policy of dairy herd improvement was initiated. The most economical method of improving live stock is by grading up, that is, using pure bred bulls of the same breed on unimproved females and their off-spring until in the 5th and 6th generations the unimproved blood is almost eliminated. This method was adopted, and as the herd sire is undoubtedly one of the first factors to be considered in a herd improvement policy, bulls of Holstein-Friesian breed selected from high milk-producing strains were imported from Canada at 9 months of age. They were kept at the Government Experimental Station and acclimatised and immunised against Anaplasmosis, a tick-borne disease of cattle that is fatal to non-immunised adult stock imported from northern countries. At 15 to 18 months of age the bulls were ready for service, and some were distributed to selected country districts.

In the areas near the Government Stock Farm, owners of dairy cows made greatest use of the bulls, so that the Department of Agriculture further imported in 1931 three Holstein bulls and some heifers from Canada, and in 1932 two bulls of Guernsey breed from the island of Guernsey, and in 1934 two Holstein bulls from Canada.

Fig. 1 shows a bull of the Holstein-Freisian breed, " Bill ", creole born, age 3 years, and Fig. 2 shows a bull of the same bred, *Orchard Leigh Heilborn Mercedes*, age 18 months, imported from Canada at 9 months of age. Bulls of this breed when bred to creole cows produce offspring that are a great improvement on their dams. They exhibit a much better dairy temperament than the creole cows as they milk well without their calves and their lactation periods are much longer. The average milk yield of the Grade Holstein is about 5,500 lbs. per annum. One of the best cows is shown in Figure 3, a half bred Holstein (pure bred bull and creole cow), that produced 6,014 lbs. milk in 272 days. Her daughter, a ¾ bred Holstein, is shown in Figure 4. She shows an improvement in body conformation and more Holstein character than her dam. Figure 5 shows a Grade Holstein Cow with a ⅞ bred Grade Heifer Calf. The calf is almost typical of the Holstein breed. Fig. 6 shows a number of grade Holstein heifers entered by their owners for competition at the Jubilee Agricultural Exhibition.

Table 1 shows yield of milk and length of lactation periods obtained from a herd of grade Holsteins and Creole cows.

TABLE 1.

Animal			*Lactation Period*	*Length*	*Milk Yield.*
1.	Holstein	1st Cross	4th	272 days	6,014 lbs.
2.	do.	1st Cross	2nd	360 „	6,650 „
3.	do.	2nd Cross	1st	306 „	5,080 „
4.	do.	1st Cross	5th	345 „	6,282 „
5.	do.	2nd Cross	1st	314 „	5,452 „
6.	Creole Cow		4th	293 „	3,302 „
7.	do. do.		4th	219 „	2,738 „
8.	do. do.		1st	365 „	5,105 „
9.	do. do.		1st	245 „	2,690 „

Due to variation in the length of individual lactation periods, in making a final summary, a more accurate comparison would be obtained by reducing all lactation periods to a standard length. The average length was found to be 302 days, and this is used as the standard in Table 2.

TABLE 2.

Animal			*Lactation Period*	*Milk Yield.*
1.	Holstein	1st Cross	4th	6,389 lbs.
2.	do.	1st Cross	2nd	6,010 „
3.	do.	2nd Cross	1st	5,040 „
4.	do.	2nd Cross	1st	5,356 „
5.	do.	1st Cross	5th	5,870 „
6.	Creole Cow		4th	3,365 „
7.	do. do.		4th	3,402 „
8.	do. do.		1st	4,440 „
9.	do. do.		1st	3,034 „

There is an average increase of 62% in the yield of milk from the grade Holsteins.

The management and seasonal conditions were exactly the same in this trial. All the animals were milked twice daily, and in the evenings turned out into a field for exercise and grazing. They were brought back to the pen in the early morning, and kept there for the day, and concentrates in the form of a balanced ration composed chiefly of local products, *i.e.*, rice meal, corn, coconut meal and cotton seed meal fed to them. Coconut and cottonseed meal were later replaced by Soya bean meal, the former not being obtainable. The amount fed was 1 lb. of the ration to every 3 lbs. milk produced. The cost of the concen-

trate part of the ration was 1·51 cents per 100 lbs. Minerals, bonemeal, lime and salt were added to the ration.

The Holstein Grade milked well without their calves, but all the Creole cows were accustomed to have their calves near them, though they were not suckled.

The creole cows were of good milking type and had been well fed and cared for many years as milch cows. It had been observed that whilst adequate and abundant food had increased the milk yield of the creole cow where selection was practised, the method was too slow for any great improvement in quantity. Therefore, for the economic production of milk, where abundant and adequate food obtains, improved methods of breeding are essential for the rapid improvement of a dairy herd. This occurred when the creole cow was mated to a pure bred bull of dairy type, their progeny yielding a greater quantity of milk and a heavier carcase than the dam.

The size of the first Cross Grade Holstein seems to be intermediate between that of the parents. The colour is usually black, although a few white spots may appear on the legs, tip of the tail or surface of the udder.

The body conformation of the 2nd Cross Grade Holstein is more like that of the pure bred parent. There are also larger patches of white on the body. The length of coat of the 1st and 2nd Cross is short and lies close to the body similar to that of the creole cow. The 3rd Cross Holstein in body conformation, colour markings and length of coat is almost typical of the pure bred parent.

The improvement in the quantity of milk is greatest in the 1st Cross Holstein. The 2nd Cross Holstein may show little if any improvement over the 1st Cross, although some individuals should show marked improvement if milk inheritance is transmitted in Mendelian fashion. It is by careful selection of the 2nd Cross generation that marked improvement in the herd will be obtained.

As soon as the 3rd Cross Holsteins come into lactation, their records will be available for comparison.

Table 3 serves to illustrate the average growth of a group of calves from birth to 6 months of age when they were weaned. They were fed on milk, grain and hay.

FIG. 2. *Orchard Leigh Heilborn Mercedes.* A pure bred Holstein Freisian Bull 18 months old imported from Canada

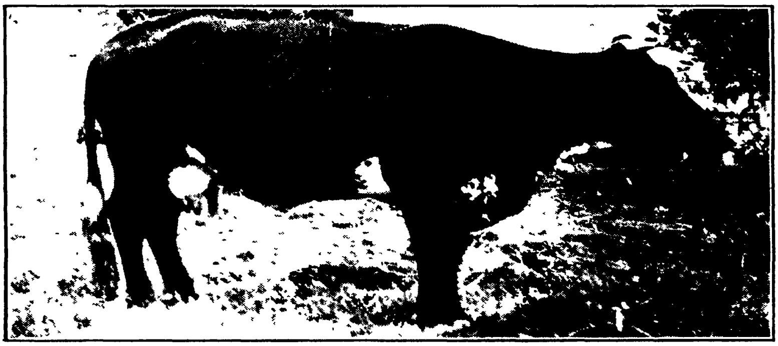

FIG. 3. *Bessy 1st.* 1st Cross Grade Holstein Cow. Produced in 272 days 6,014 lbs. milk.

FIG. 4. *Bessy 2nd.* 2nd Cross Grade Holstein Cow. Produced in her 1st lactation period of 306 days, 5,080 lbs. milk.

PLATE XXII

Fig. 5 A Grade Cow and 3rd Cross Holstein Heifer Calf. The Calf is four months old

Fig. 6. A Group of Grade Holstein Heifers at Jubilee Agricultural Exhibition

TABLE 3

Animal	*Age*	*Daily Feed*	*Daily Gain*	*Weight at Weaning.*
1st Cross Holstein 65 lbs. at birth	1st mth.	8.00 lbs.	1.29 lbs.	
	2nd „	9.06 „	1.00 „	
	3rd „	13.00 „	1.61 „	
	4th „	12.40 „	1.72 „	
	5th „	10.00 „	1.45 „	330 lbs.
	6th „			
2nd Cross Holstein 72 lbs. at birth	1st mth.	9.35 lbs.	1.80 lbs.	
	2nd „	12.50 „	1.70 „	
	3rd „	11.00 „	1.06 „	
	4th „	10.51 „	1.49 „	
	5th „	10.00 „	1.40 „	
	6th „	7.80 „	.74 „	323 lbs.
3rd Cross Holstein 62 lbs. at birth	1st mth.	8.20 lbs.	1.47 lbs.	
	2nd „	9.53 „	1.89 „	
	3rd „	12.06 „	1.45 „	
	4th „	14.00 „	1.00 „	
	5th „	15.00 „	2.26 „	
	6th „	13.40 „	1.00 „	340 lbs.

The calves were removed from their mothers 72 hours after birth and pail fed. Whole milk was fed throughout the period. In the second month $\frac{1}{4}$ lb. grain daily was added and gradually increased to $\frac{1}{2}$ lb. by the end of the month. At the beginning of the 6th month 4 lbs. grain was being fed daily and the milk gradually reduced to nil. The calves, when weaned, were well grown and in good thrifty condition. A fluctuation in the daily gain in weight was observed some months. This coincided with sudden changes in the feeding methods, and is to be avoided as such changes cause digestive disturbances and interfere with the rate of growth.

As the food supply is one of the chief factors influencing the rate of growth, an abundant and adequate supply is necessary for the full development of the young growing animal. An animal's development is definitely limited by its inheritance, but what it may become depends on the full development of that inheritance by a favourable environment. A well developed animal may be bred 2 to 8 months earlier than one whose growth has been retarded as a result of an insufficient food supply. This is of great economic importance in the production of milk where intensive methods are practised. A young growing animal will continue to grow in height and length although very poor in flesh and will not lose the capacity to grow if later a greater abundance of food is supplied.

The growth of many of the calves in the milk-producing herds of the Colony is stunted due to this insufficiency of food, and hence they are not bred until about 3 to $3\frac{1}{2}$ years old.

The feed cost at the end of six months averaged $65 per head, due principally to the cost of milk. This is of practical interest to the dairyman who has a ready sale for his milk, for it would be more economical to purchase his milking stock than to raise his calves. The large producer of milk who finds difficulty in marketing his milk might consider the raising of dairy animals for sale.

The above information clearly demonstrates the marked superiority of the grade Holstein over the Creole cattle, both in milk yield and cost of keep. Much more work needs to be done in the out districts, and there is a great need for co-operation between livestock owners and the Department of Agriculture. It would be well if the larger villages made some provision on their annual estimates for the purchase and keep of an improved type of bull, either pure bred or grade, for their cattle.

The result of the system of grading up may be summarised as follows :—

(1) An increase in milk production due to the use of pure bred sires.

(2) It pays to purchase sires from high producing dams so that these inherited factors may be transmitted to their daughters.

(3) Maximum production and growth cannot be assured by improved methods of breeding alone; proper and adequate methods of feeding are essential.

(4) The cost of production is much less.

(5) An improved carcase of beef is obtained.

(6) A cleaner and more wholesome product is obtained.

THE VARIETY AND FERTILISER POSITION OF THE SUGAR INDUSTRY.

BY

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Large Scale Tests with Cane Seedlings.—The last issue of the *Journal* contained a series of comparisons between the yields given on a Berbice estate by the standard cane (D. 625) and the varieties P.O.J. 2878, Diamond 10, S.C. 12 (4) and D. 835/18. The results there given have been fully confirmed by further tests, the data for which, kindly supplied by the Manager, are summarised below. Each comparison is made between varieties grown on two sides of the same field or in adjacent fields.

P.O.J. 2878 and D. 625.

Plant Canes.

Acres of Each Cane Reaped.	Age of Canes, Months.	P.O.J. 2878			D. 625		
		Sucrose, lbs. per gallon.	Purity.	Sugar per acre, Tons.	Sucrose, lbs. per gallon.	Purity.	Sugar per acre, Tons.
6.5	11.75	1.521	83.3	5.84	1.406	78.3	5.23
6.5	11.75	1.524	83.5	5.38	1.437	79.0	4.92
6.25	11.5	1.579	83.9	5.28	1.403	79.1	4.96
6.25	11.5	1.579	83.1	5.76	1.318	78.0	4.64
6.25	11.5	1.527	81.9	4.96	1.226	75.9	4.00
12.5	11	1.509	83.2	5.04	1.402	79.5	4.16
6.0	12.5	1.513	82.8	6.16	1.378	80.0	5.16
5.5	12 5	1.521	82.7	5.81	1.266	77.6	4.00
Mean		1.534	83.0	5.47	1.354	78.4	4.59

Diamond 10 and D. 625.

Plant Canes.

Acres of Each Cane Reaped.	Age of Canes, Months.	Diamond 10			D. 625		
		Sucrose, lbs. per gallon.	Purity.	Sugar per acre. Tons.	Sucrose, lbs. per gallon.	Purity.	Sugar per acre, Tons.
6.25	11.5	1.547	82.7	4.32	1.312	78.4	4.32
6.25	11.25	1.527	82.6	4.64	1.376	79.2	4.48
6.25	11.25	1.616	84.0	4.48	1.439	79.9	4.64
Mean		1.563	83.1	4.48	1.375	79.1	4.48

Diamond 10 and D. 625.

Second Ratoons.

Acres of Each Cane Reaped.	Diamond 10			D. 625		
	Sucrose, lbs. per gallon.	Purity.	Sugar per acre, Tons.	Sucrose, lbs. per gallon.	Purity.	Sugar per acre, Tons.
3.75	1.596	83.3	4.57	1.519	82.0	2.97

D. 835/18 and D. 625.

Plant Canes.

Acres of Each Cane Reaped.	Age of Canes, Months.	D. 835/18			D. 625		
		Sucrose, lbs. per gallon.	Purity.	Sugar per acre, Tons.	Sucrose, lbs. per gallon.	Purity.	Sugar per acre, Tons.
6.25	11.25	1.418	81.5	4.32	1.464	80.2.	4.32

P.O.J. 2878, S.C. 12 (4) and D. 625.

Plant Canes.

Variety.	Acres Reaped.	Sucrose, lbs. per gallon.	Purity.	Sugar per acre, Tons.
P.O.J. 2878	8.5	1.514	81.5	6.33
S.C. 12(4)	17.0	1.534	84.1	4.85
D. 625	8.5	1.263	77.5	4.00

S.C. 12 (4) and D 625.

Second Ratoons.

Variety.	Acres Reaped.	Sucrose, lbs. per gallon.	Purity.	Sugar per acre, Tons.
S.C. 12(4)	9	1.620	85.5	4.33
D. 625	9	1.524	81.5	3.61

In these as well as in the trials reported previously, P.O.J. 2878 has proved its superiority to D. 625 as a plant cane on this estate. Ratoon results are anxiously awaited.

Diamond 10 has better juice qualities but yields about the same amount of sugar per acre, as a plant, as the standard cane. In the second ratoon test reported it was definitely better than D. 625.

S.C. 12 (4) which has excellent juice qualities, appears to ratoon remarkably well on this estate.

Estate Yields in 1934.—The sugar estates of the Colony have very kindly supplied the Department of Agriculture with statistics of the yields secured from different varieties during the 1934 harvests. The data given are summarised in the Table which follows.

WEIGHTED MEAN YIELDS OF 96° SUGAR PER ENGLISH ACRE FROM THE MAJOR VARIETIES GROWN IN BRITISH GUIANA IN 1934.

		Frontland Soils.							Pegasse Soils.					
		D. 625	Diamond 10	Mixed	D. 118	B.H. 10 (12)	P.O.J. 2878	S.C. 12 (4)	D. 625	D. 118	Diamond 10	Mixed	P.O.J. 2878	B.H. 10 (12)
Plant Canes	Acres Reaped:	8,748.5	3,266.4	821.6	779.7	334.4	398.4	228.9	1,202.8	309.5	109.1	...	59.9	...
	Yield of Sugar per Acre, Tons:	3.18	3.16	2.63	2.66	2.67	3.90	2.97	3.18	2.29	2.73	...	3.67	...
First Ratoons	Acres Reaped:	8,060.1	2,436.2	1,192.7	757.3	205.0	26.2	111.8	1,713.7	438.2	93.3	55.8	..	7.3
	Yield of Sugar per Acre, Tons:	2.50	2.67	1.88	1.92	2.57	2.81	2.87	2.35	1.66	2.75	2.53	..	2.46
Second Ratoons	Acres Reaped:	5,654.4	1,662.1	1,424.3	557.3	122.2	..	21.5	748.0	378.7	18.9	18.9	..	...
	Yield of Sugar per Acre, Tons:	2.48	2.53	1.79	1.78	2.31	...	3.50	1.72	1.38	4.40	3.35	...	...
Three Crops: Total Yield of Sugar per Acre, Tons:		**8.16**	**8.36**	**6.30**	**6.36**	**7.55**	..	**9.34**	**7.25**	**5.33**	**9.88**	..	..	..

Diamond 10 and P.O.J. 2878 continue to outyield D. 625, while areas returned as 'mixed' and those planted to D. 118 give distinctly lower yields than those devoted to the standard cane. Diamond 10 probably did much better than appears from the table for it forms a high percentage of the area reaped on certain estates known to possess large pegasse areas, but which did not separate their returns from the two soil types. In consequence, the returns from these estates are given under "frontland soils" and their Diamond 10 returns suffer by comparison with the returns from D. 625 really grown on frontland.

Cane Varieties to be Harvested in 1935.—It is important for planters as well as for the Department of Agriculture to know what cane varieties are being grown and which variety is most favoured in a particular district. The Department is consequently very grateful to the sugar estate managers for sending in returns of the areas to be reaped. The data supplied have been summarised in the two tables which follow. The area in D. 625 still far exceeds that in any other variety. It is, however, tending to decrease, the area to be harvested this year being about 2,000 acres less than that returned to be harvested in 1934. On the other hand the areas in Diamond 10 and P.O.J. 2878 tend to increase, the figures for 1935 showing increases of 4,000 and 2,000 acres, respectively, over those for 1934. D. 625 is concentrated largely in Berbice and East Demerara, Diamond 10 along the Demerara River Banks and in West Demerara. Areas returned as 'Mixed' and areas planted to D. 118 are to be found mainly in West Demerara and along the Demerara River Banks. The 2,764 acres of P.O.J. 2878 are distributed mainly between Berbice and East and West Demerara. B.H. 10 (12) and S.C. 12 (4) are most favoured in West Demerara and along the Demerara River Banks.

PERCENTAGE DISTRIBUTION OF THE VARIETIES TO BE REAPED IN 1935.

(Varieties listed represent 99.0% of the Total Area to be Harvested.)

Variety.	Total English Acres in the Colony (100.0%)	Percentage in West Demerara.	Percentage along Demerara River Bank	Percentage in East Demerara.	Percentage in Berbice.
D. 625 :	32,429.2 (55.4%)	0.5	7.8	35.3	56.4
Diamond 10 :	13,303.5 (22.7%)	28.9	53.9	7.1	10.1
Mixed :	7,363.4 (12.6%)	52.5	31.1	2.4	14.0
P.O.J. 2878 :	2,763.7 (4.7%)	25.0	6.1	34.3	34.6
B.H. 10 (12) :	810.1 (1.4%)	61.2	21.5	12.3	5.0
S.C. 12 (4) :	663.9 (1.1%)	46,1	28.2	5.9	19.8
D. 118 :	660.2 (1.1%)	23.3	75.7	...	1.0

Varietal Composition of the Cane Areas to be Reaped in the Various Districts in 1935.

(Varieties listed represent 99.0% of the total area to be harvested.)

District.	D. 625.		Diamond 10.		Mixed.		P.O.J. 2878.		B.H. 10 (12).		S.C. 12 (4).		D. 118.		Total English Acres to be Reaped in District.
	English Acres.	Per cent. of Total Area to be Reaped in District.	English Acres.	Per cent. of Total Area to be Reaped in District	English Acres.	Per cent. of Total Area to be Reaped in District.	English Acres.	Per cent of Total Area to be Reaped in District	English Acres.	Per cent. of Total Area to be Reaped in District.	English Acres.	Per cent. of Total Area to be Reaped in District.	English Acres.	Per cent. of Total Area to be Reaped in District.	
West Demerara:	155.2	1.6	3,840.6	40.4	3,865.6	40.7	691.7	7.3	495.7	5.2	306.1	3.2	153.9	1.6	9,508.8
Demerara River Banks:	2,519.1	19.4	7,173.1	55.1	2,288.8	17.6	167.3	1.3	174.2	1.3	187.0	1.4	499.5	3.9	13,009.0
East Demerara:	11,452.5	83.8	948.8	7.0	175.1	1.3	948.6	6.9	100.0	0.7	39.3	0.3	—	—	13,664.3
Berbice:	18,302.4	83.9	1,341.0	6.2	1,033.9	4.7	956.1	4.4	40.2	0.2	131.5	0.6	6.8	—	21,811.9
Colony:	**32,429.2**		**13,303.5**		**7,363.4**		**2,763.7**		**810.1**		**663.9**		**660.2**		**57,994.0**

Fertilizers in 1934.—As previously stated (*Agricultural Journal*, Vol. V, pp. 253-267) practically all the fertilizers used in British Guiana are employed in the sugar industry and, since there is no local source, all fertilizers are imported. Statistics of the 1934 imports are now available from the Customs' returns, and the sugar estates have kindly supplied data for the same year as to the manures used, cost, etc. It is thus possible to bring Table III appearing on page 260 of the December issue of the *Journal* up to date, and to complete and amplify Table IV which appeared on page 261.

Fertilizers Imported into British Guiana in Recent Years.

Year.	Nitrogenous Fertilizers (almost entirely Sulphate of Ammonia).			Manurial Lime (including Limestone).			Other Fertilizers (mainly Superphosphate and Basic Slag with some Sulphate of Potash).			Total Imports.	
	Tons.	Value, $.	Value per Ton. $.	Tons.	Value. $.	Value per Ton. $.	Tons.	Value. $.	Value per Ton, $.	Tons.	Value. $.
1926	6,691	403,407	60.29	2,806	32,952	11.74	2,072	42,100	20.32	11,569	478,459
1927	7,271	393,084	54.06	3,507	40,777	11.63	3,871	94,826	24.50	14,649	528,687
1928	6,721	359,526	53.49	3,766	41,290	10.96	2,277	47,139	20.70	12,764	447,955
1929	6,693	358,231	53.52	2,560	26,051	10.18	2,971	71,189	23.96	12,224	455,471
1930	7,207	316,158	43.87	2,754	27,394	9.95	2,624	62,069	23.65	12,585	405,621
1931	7,165	249,107	34.77	3,239	32,984	10.18	3,226	83,460	25.87	13,630	365,551
1932	8,294	254,726	30.71	4,366	42,071	9.64	2.619	54,281	20.73	15,279	351 078
1933	7,681	263,456	34.30	4,749	42,569	8.96	2.937	76,617	26.09	15,367	382,642
1934	7,727	248,185	32.12	4,306	38,524	8.95	2.168	48,735	22.48	14,201	335,444
Mean :	**7,272**	**316,209**	**43.48**	**3,561**	**36,068**	**10.13**	**2,752**	**64,491**	**23,43**	**13,585**	**416,768**
% of Annual Imports:	**53.53**	**75.87**		**26.21**	**8.65**		**20.26**	**15.47**			

Fertilizers used on British Guiana Sugar Estates in 1933 and 1934.

FERTILIZER	QUANTITY				VALUE					
	Tons		Per cent. of Total		$		Per cent. of Total		Per Ton, $	
	1933	1934	1933	1934	1933	1934	1933	1934	1933	1934
Sulphate of ammonia	7,274.56	7,932.10	53.0	51.6	284,681.72	310,268.18	71.3	71.0	39.13	39.12
Barbados lime	3,129.85	3,533.25	22.8	23.0	38,263.01	42,072.23	9.6	9.6	12.23	11.91
Basic Slag	1,249.05	1,254.80	9.1	8.2	30,453.02	29.662.35	7.6	6.8	24.38	23.64
Superphosphate of lime	1,002.60	1,171.00	7.3	7.6	26,212.45	29,940.54	6.6	6.9	26.14	25.57
Pulverised limestone	924.50	1,286.70	6.7	8.4	9,619.38	14,100.67	2.4	3.2	10.40	10.96
Sulphate of potash	150.35	168.70	1.1	1.1	9,767.73	10,299.94	2.5	2.4	64.97	61.05
Ammonium phosphate	1.00	10.00	...	.1	69.02	510.73	...	0.1	69.02	51.07
Nitrate of soda	...	1.70	...	...	...	28,56	...	...	...	16.80
Plutophos	0.45	...	...	...	17.63	...	...	...	39.18	...
TOTAL	**13,732.36**	**15,358.25**	**100.0**	**100.0**	**399,083 96**	**436,883.20**	**100.0**	**100.0**		

Imports of Sulphate of Ammonia, which average 53.5 per cent. of the quantity and 75.9 per cent. of the value of fertilizers imported, were slightly

higher in 1934 than in the previous year and exceed considerably the mean figure for the imports of the past nine years. The c.i.f. price per ton shows a decline of $2.18 as compared with the figure for 1933. This drop is not reflected in the "landed on the estate" cost supplied by the plantations. The estates report using 658 tons more Sulphate of Ammonia in 1934 than in 1933, from which year there was, apparently, a carry-over of stocks.

Lime and limestone imports show a decline of 443 tons but the c.i.f. cost per ton has remained unchanged. There was a carry-over of several hundred tons from 1933 to 1934 and the estates report using 404 tons of Barbados lime and 362 tons of limestone more in the latter than in the former year.

Imports of "Other Fertilizers" show a decrease of 769 tons in 1934 as compared with 1933. Here too, there was a considerable carry-over from 1933, for the estates report using slightly more basic slag, superphosphate and sulphate of potash in 1934. The c.i.f. price per ton for this group shows a drop of $3.61 in 1934 as compared with 1933. The "landed on the estate" cost per ton seems to have benefitted by this reduction.

It is interesting to compare, in the following Table, the Customs' c.i.f. values per ton of fertilizer for the years 1933 and 1934 with the cost of these same fertilizers landed on the estate. It will be seen that the difference varies considerably from manure to manure and year to year.

C.I.F. Costs of Fertilizers and Final Costs to Estates.

	1933			1934		
	Customs' c.i.f. Value per ton, $	Estates' landed Value per ton, $	Difference $	Customs' c.i.f. Value per ton, $	Estates' landed Value per ton, $	Difference, $
Sulphate of ammonia	34.30	39.13	5.83	32.12	39.12	7.00
Lime and limestone	8.96	11.81	2.85	8.95	11.65	2.70
Other fertilizers	26.09	27.68	1.59	22.48	27.03	4.55

RECENT ENTOMOLOGICAL INVESTIGATIONS.

BY

F. A. SQUIRE, B.Sc., A.I.C.T.A., F.R.E.S.,

Supernumerary Entomologist, British Guiana.

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(1) HARDNESS OF RICE.

In the course of an investigation of the rice weevil *Calandra oryzae* L. in stored rice in British Guiana which was started about four years ago it became desirable to ascertain the hardness of different varieties and types of rice. This was done by means of a beam already described (2) and the results obtained were published in (2) and (3) and may be summed up as follows:—

Of the dozen varieties tested there proved to be no varietal difference in hardness, but it was found that the parboiled type is several times as hard as white rice. Furthermore, the hardness is apparently correlated with moisture content, for on heating the rice, some of the water is driven off and the hardness increased. When normal conditions are restored these changes are gradually reversed.

In pursuance of this question, samples of rice were tested for hardness on successive days and the results obtained showed that the hardness and the atmospheric humidity are negatively correlated. Owing to the rapid fluctuations in the latter however, and the lack of a continuous reading Hygrograph the results did not appear very conclusive on paper and it became apparent that the correlation could be best demonstrated by keeping samples of rice in atmospheres of constant Relative Humidity.

This was done by means of two lots of desiccator jars. One dozen contained a 16 per cent. KOH solution which produced an atmosphere of Relative Humidity 90 per cent. A similar number contained a 51 per cent. solution (1) which produced atmosphere of 50 per cent. Relative Humidity. Samples of rice were placed in each of the desiccators which were then closed down and one from each series was opened and the samples inside tested on each of ten succeeding days. The test for hardness in every case was based on three hundred grains.

The results obtained are summed up in the following tables :—

BEHAVIOUR OF RICE: VAR: DEMERARA CREOLE IN 50% R.H.

Days	Hardness in terms of inches on lever	Standard Error of Hardness	Weight of Samples
1st	20.13	.1706	19.975 gms.
2nd	21.03	.1886	19.995 ,,
3rd	23.35	.2100	19.890 ,,
4th	23.28	.1894	19.875 ,,
5th	23.93	.2086	19.820 ,,
6th	24.71	.2012	19.790 ,,
7th	25.15	.1921	19.730 ..

Percentage increase in hardness	Percentage loss in weight
24.94	1.226

BEHAVIOUR OF RICE: VAR: DEMERARA CREOLE IN 90% R.H.

Days	Hardness in terms of inches on lever	Standard Error of Hardness	Weight of Samples
1st	14.11	.1580	20.295
2nd	12.86	.1244	20.480
3rd	11.66	.1216	20.690
4th	11.73	.1114	20.735
5th	11.42	.1170	20.755
6th	10.36	.1160	20.850
7th	10.38	.1048	20.870
8th	10.11	.1109	21.020
9th	8.35	.1598	21.045
10th	7.97	.1792	21.080
11th	7.215	.1941	21.310

Percentage loss in hardness	Percentage increase in weight
48.87	4.99

From the tables and the accompanying graphs it will be seen that there is an increase in weight coupled with a drop in hardness in the case of the samples kept at 90 per cent. Relative Humidity and just the reverse with those at 50 per cent. Relative Humidity. These changes take place gradually over a period of

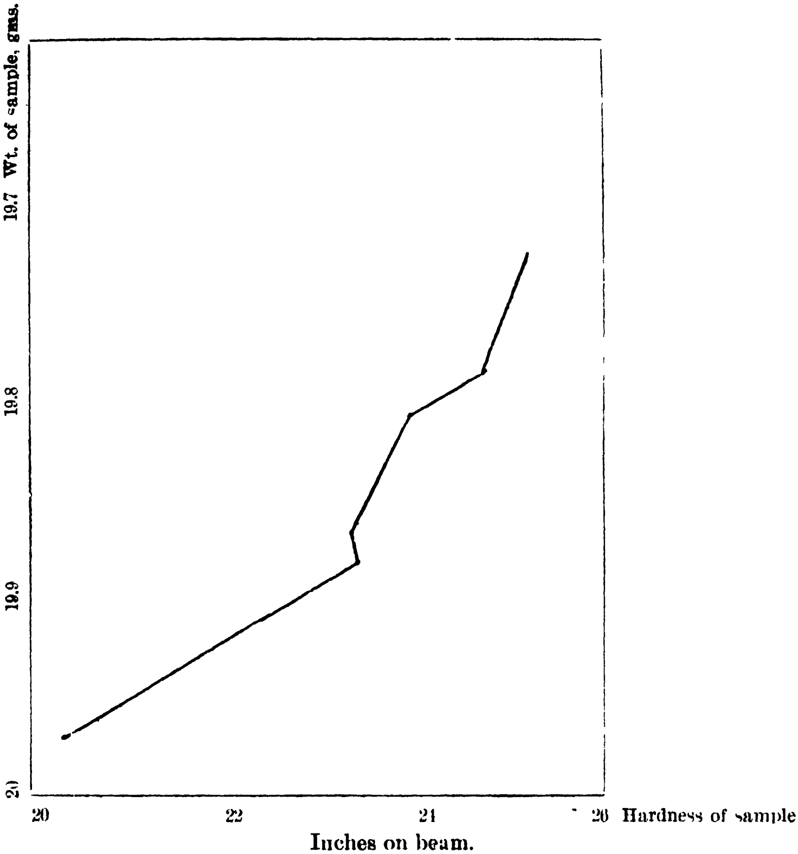

FIG. 1. Parboiled rice Var. Demerara Creole on successive days in Atmosphere of R.H. of 50%.

7 to 11 days after which permanent transformations in the structure occur. Thus after 11 days the grains at the higher humidity began to crumble whilst those at 50 per cent. Relative Humidity in 7 days reached their maximum hardness and loss of moisture. At this stage, transverse fissures about 1 millimetre apart, began to appear in the grains shortly after they were again exposed to the air causing them to disintegrate with the greatest ease.

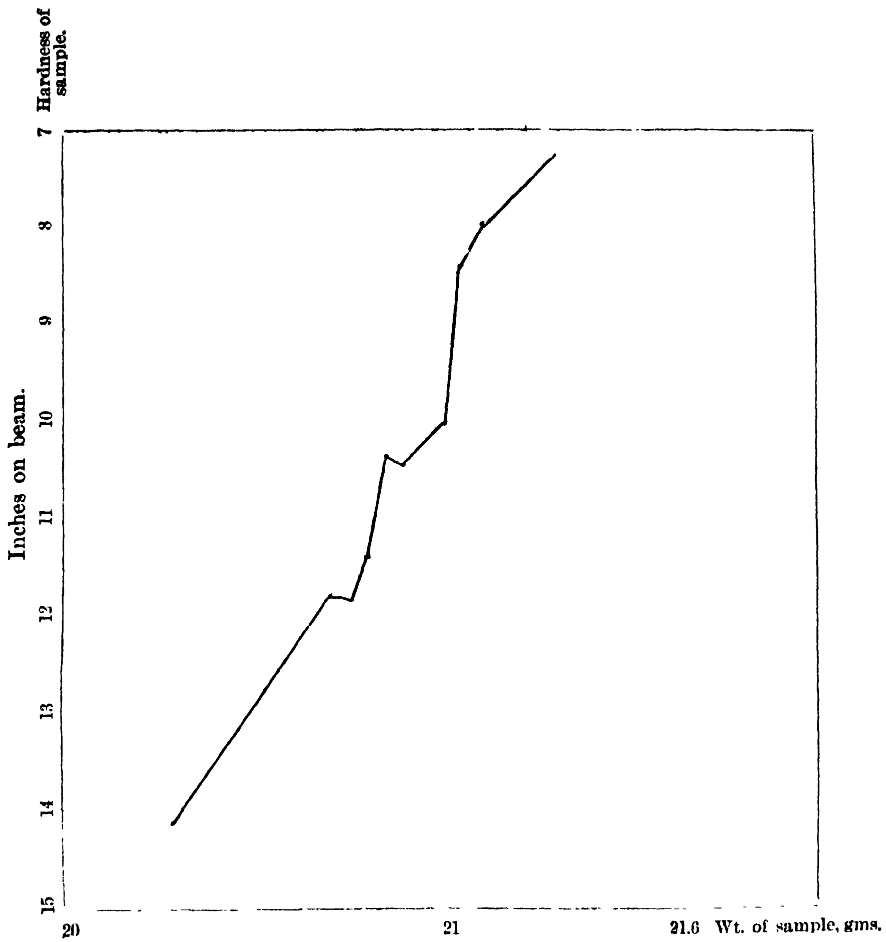

FIG. 2. Parboiled rice Var. Demerara Creole on successive days in Atmosphere of R.H. 90%.

CONCLUSION.

Between these limits it will be seen there is a difference in hardness of 17.9 inches on the lever or 10.23 lbs. pressure required to crack the grain and that the percentage moisture content calculated on the weight of the sample at about 70 per cent. Relative Humidity which is the average Relative Humidity in Georgetown varies from a loss of 1.2 per cent. in the case of the 50% R.H. to a gain of 4.99 per cent. in the case of the 90% R.H.

Finally it may be pointed out again that parboiling permanently increases the hardness of rice, and whilst the hardness of white rice (*i.e.*, unparboiled rice) also varies with humidity, it can never at any time compare with the parboiled

type for hardness. The question of parboiling is very little understood and the conditions under which it is carried out are quite haphazard so that it may be doubted whether the maximum induration possible is obtained by the process in vogue at the present time in British Guiana, and whether better results could not be produced by making a closer study of the question. Not only from an entomological point of view is this of importance, but since grain breakage in milling is largely a question of hardness, there is on those grounds alone, sufficient justification for a closer investigation of the process of parboiling.

REFERENCES.

(1) BUXTON, P. A. The measurement and control of atmospheric humidity in relation to entomological problems, Bull. Ent. Res. Vol. XXII, p. 431.

(2) SQUIRE, F. A. Bull. Imp. Inst. Vol. XXXI, No. 1. pp. 78–81, 1933.

(3) ———————Rice Bull. No. 1, p. 53, 1933, Dept. of Agric., British Guiana.

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(2) ADDITIONS TO ENTOMOLOGICAL COLLECTION.

The following insects not previously recorded from British Guiana by the Department of Agriculture were added to the collection during the past four years. The majority were collected on the coastal belt of the province of Demerara and in the North West District of the province of Essequibo. Some were taken in the environs of Georgetown and a few at Dalgin on the Demerara river and Arakaka on the Barima river, so that practically all form part of the coastal insectan fauna. A small proportion consists of insects of economic importance that have only recently claimed attention and some of the Diptera and Hymenoptera are parasitic on a wide range of hosts including several that do considerable damage.

The rest of the insects listed though of little or no importance to the local agriculturist, are nevertheless mentioned in the belief that the determinations may be of assistance to workers elsewhere in studying the ecology and geographical distribution of species or groups in which they may be particularly interested.

All of these determinations were made by the Imperial Institute of Entomology.

COLEOPTERA

Carabidae
Clivina elongata Chaud.
Distichus orientalis Bon.

Gyrinidae
Gyrinus guianus Ochs.

Staphylinidae
Philonthus ventralis Gr.
Lathrobium nitidum Er.

Trogositidae
Temnochila lebasi Rtt.

COLEOPTERA—(*Contd*).

Cucujidae
Silvanus surinamensis L.
Laemophloeus pusillus Schon.

Dermestidae
Attagenus gloriosae F.

Lampyridae
Aspidosoma pallidum Ol.
Photinus luciolus L.
Lucidota thoracica Ol.
Aspidosoma laterale F. var.

Tenebrionidae
Hopatrinus gemellatus Ol.
Cyrtosoma cruentatum Chev.
Nyctobates gigas L.
Palorus ratzburgi Wisem.

Rhipiphoridae
Macrosiagon sp.

Bruchidae
Bruchus analis F.

Galerucidae
Diabrotica tripunctata F.
Diabrotica laeta F.

Halticidae
Lactica varicornis Jac. var.
Systena testaceovittata Clk.

Cassididae
Omaspides pallidipennis Boh.

Lamiidae
Carterica cinctipennis Pasc.
Anispous sparsus Bates.

Eumolpidae
Typophorus fasciatus F. var.
Lepronota erythropus Har.

Curculionidae
Otidocephalus fasciatus F.
Eurrhinus adonis Hust.
Catolethrus fallax Boh.

Scolytidae
Coccotrypes dactyliperda F.

Rutelidae
Lobogeniates waraputanus Ohs.
Leucothyreus metallescens Burm.

Aphodiidae
Ataenius gracilis Melsh.

Dynastidae
Coelosis bicornis F.
Bothynus sp. near *tabius* Frm.

LEPIDOPTERA

Pyralidae
Corcyra cephalonica Stt.
Hellula phidilealis Wlk.
Phostria simialis Guen.
Argyria lacteela F.
Psara bipunctalis F.

Megalopygidae.
Megalopyge tharops Stoll.

Gelechiidae
Oecia oecophila Staud.

Tineidae
Tinea allutella Reb.

Limacodidae
Phobetron hipparchia Cram.

Lycaenidae
Tmolus echion Butl.

Hesperiidae
Thymele fulgerator Walch.

Sphingidae
Enyo japix Cram.
Nyceryx continua Wlk.

Notodontidae
Hapigea curvilinea Schause.
Hapigea obliqua Wlk.
Hemiceras nubilata Schauses.

Geometridae
Prochoerodes tetrazonata Guen.
Semiothisa agnitaria Hb.

Syntomidae
Macrocneme vittata Wlk.
Isanthrene porphyria Wlk.
Euagra coelestina Cram.

Arctiidae
Idalus admirabillis Cram.
Josiodes batesi Feld
Calidota similis Hmps.

Dioptidae
Myonia priverna Cram.

Noctuidae
Gerespa fasciolaris Hb.
Phytometra oo Cram.

HYMENOPTERA

Tenthredinidae
Proselandria sp.
Braconidae
Apanteles albinervis Cam.
Hecabolus sp.
Ichneumonidae
Mesostenoideus sp.
Evaniidae
Evania rodwagi Cam.
Chalcididae
Hexasmicrus obliterans walk.
Eurytomidae
Eurytoma couridae Cam.
Bephrata maculicollis Cam.
Torymidae
Torymus guyanaus Cam.
Lochites auriceps Ashm.
Encyrtidae
Homalotylus terminalis Say.
Scelionidae
Hadronotus rugosithorax Ashm.

DIPTERA.

Tipulidae
Holorusia associans Walk.
Stratiomyiidae
Microchrysa bicolor Weid.
Sargus alchidas Walk.
Acanthina amenides Walk.
Sturmia sp.
Odontomyia subcuprata Walk. var.
Tabanidae
Tabanus inanis F.
Tabanus hookeri Knab.
Chrysops laeta F.
Diachlorus diversipes Macq.
Dolichopodidae
Condylostylus radians Macq.
Syrphidae
Toxomerus musicus F.
Eristalis fasciata
Eristalis aemulus Will.
Rhingia sp.
Baccha clavata F.
Ortalidae
Richardia calcarata Hend.
Xanthocrona phyllochaeta Hend.
Lonchaeidae
Lonchaea pendula Bezzi.
Micropezidae
Ptilosphen insignis Wied.
Trypetidae
Blepharoneura poecilosoma Schin.
Agromyzidae
Agromyza viridis Hend.
Muscidae
Synthesiomyia nudiseta Wulp.
Sarcophagidae
Sarcophaga chrysostoma Wied.
Sarcophaga lambens Wied.
Tachinidae
Archytas pilosa Wlk.
Chaetolyga pyrrhopyga Weid.
Microphthalma lativentris Curran.

ANOPLURA

Menoponidae
Colpocephalum subpachygaster Piaget.
Heterodoxus longitarsus Piaget.

SEASONAL VARIATION AND PEASANT AGRICULTURAL CREDIT IN BRITISH GUIANA.

BY

H. D. HUGGINS, M.Sc., DIP. AGR.

INTRODUCTION.

The object of this study was to ascertain how the demand for agricultural credit and the repayment of loans to credit banks varied within the year for different districts of British Guiana. The monthly transactions for a period of eleven years in each of nine banks and for ten years in one bank have been studied. The results obtained in the case of each bank have been accepted as applying only to the district served by the bank under consideration and no attempt has been made to evolve generalisations. Credit is provided by the banks for widely differing purposes ("development of land or for any other industrial pursuit"); nevertheless, each bank is a small independent unit functioning in a circumscribed area; the controlling conditions are similar enough in the case of the majority of creditors in each district to lead to seasonal variation in the cash transactions of the respective banks.

MEANS OF OBTAINING AGRICULTURAL CREDIT IN BRITISH GUIANA.

The sugar-producing estates in British Guiana are owned by large, limited liability companies and financed through the commercial banks operating in the Colony. The production of crops other than sugar is by small farmers who are not granted credit by the commercial banks on the types of security usually offered. A limited amount of credit is obtained from Insurance Societies by farmers who own readily convertible property. The bulk of the credit needed by the farmer had, therefore, to be provided by the shopkeeper, the estate proprietor, the merchant and the money-lender. In 1911, the Committee (under the chairmanship of the then Governor) of the Combined Court appointed to consider the advisability of establishing agricultural loan banks in the Colony recommended* *inter alia* :—

(1) that the establishment of co-operative credit banks was desirable in British Guiana;

(2) that banks of an unlimited liability type were unsuitable for British Guiana and that a member's liability should be limited to his or her share capital;

(3) that each bank established should have its own membership, have its own Committee of Management and be independent of any other bank;

*Combined Court No. 616, 1911: First Special Session 1911.

(4) that a Government appointee should be chairman of the Committee of Management of each Bank which was indebted to Government;

(5) that a Co-operative Credit Banks Board should be appointed to supervise the loaning and repayment of Government money and to advise Government generally.

The above recommendations have become the basis of the peasant credit system in British Guiana. Ordinance No. 9 was passed in 1914 and from 1915 a number of co-operative credit banks have, with rules based on the principles recommended in the Committee's report, been established in centres where the necessity seemed to exist. In Table 1 are shown the total amounts, loaned year by year by all co-operative credit banks in British Guiana, from the inception of the present system (1916 to 1933). There has been a tendency for the total amounts loaned to decrease for the period 1916–33; the trend is found to be at the declining rate of 3.85 per cent. per annum; the trend for the period studied, 1923–33, is also downward (2.6 per cent. per annum) but the decline has not been as rapid as for the period 1916–1922.

TABLE I.

Total Annual Loans made by all Credit Banks in British Guiana, 1916–33.

YEAR	LOANS $
1916	8,568
1917	29,161
1918	60,139
1919	84,971
1920	138,148
1921	82,937
1922	15,947
1923	19,573
1924	19,959
1925	75,986
1926	54,521
1927	36,844
1928	29,391
1929	31,861
1930	36,150
1931	20,739
1932	40,346
1933	24,602

Capital for the banks is provided by shares which are sold at a value of $1.00 each. In addition, section No. 6 of the above-mentioned Ordinance makes provision for the application to Government for loans from public funds to augment the working capital. Government have usually granted loans on the basis of $1.00 for every dollar of a borrowing bank's paid up capital and

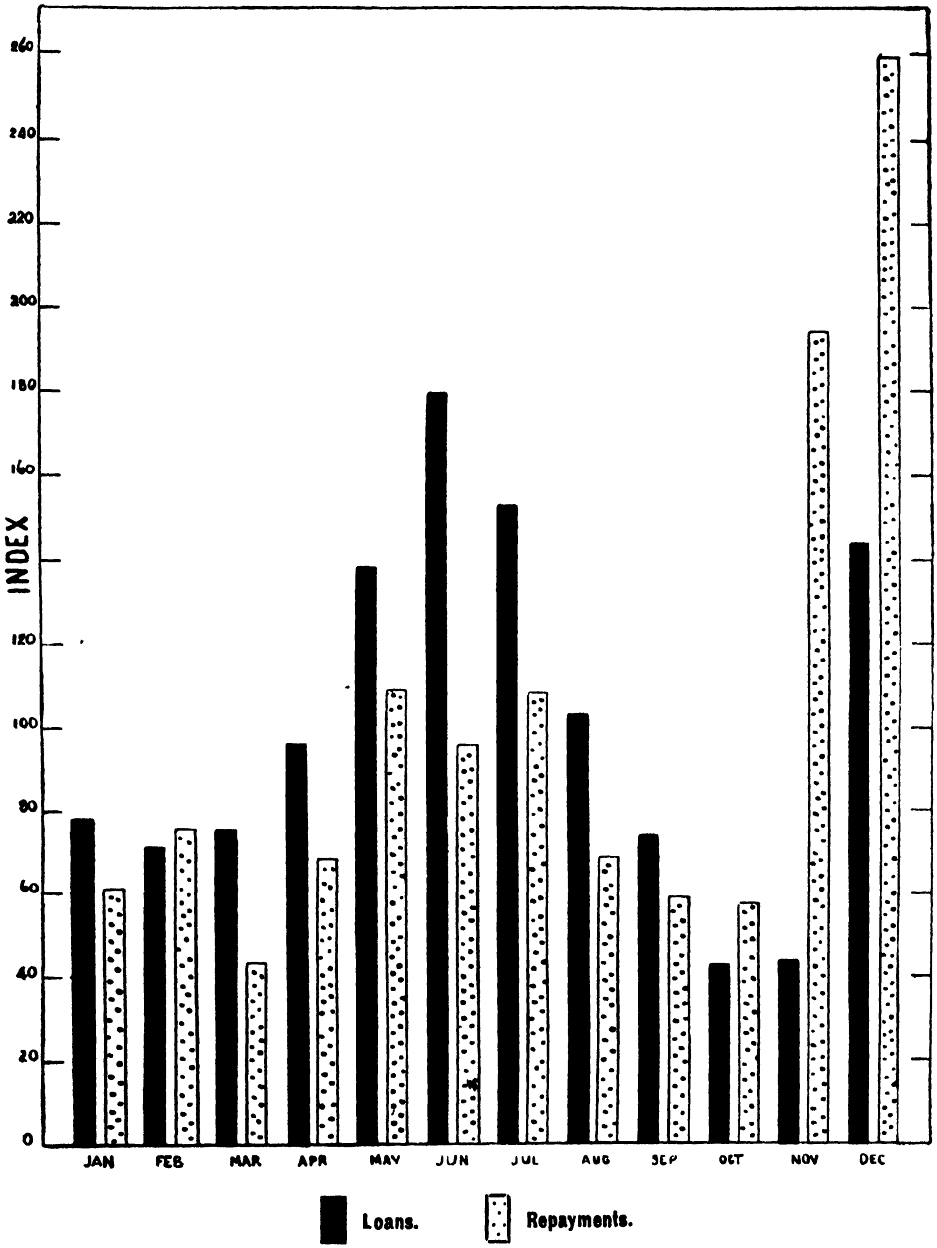

FIG. 1. In the south Essequibo area, highest loans were taken from May to July and in December, and highest repayments made in November and December.

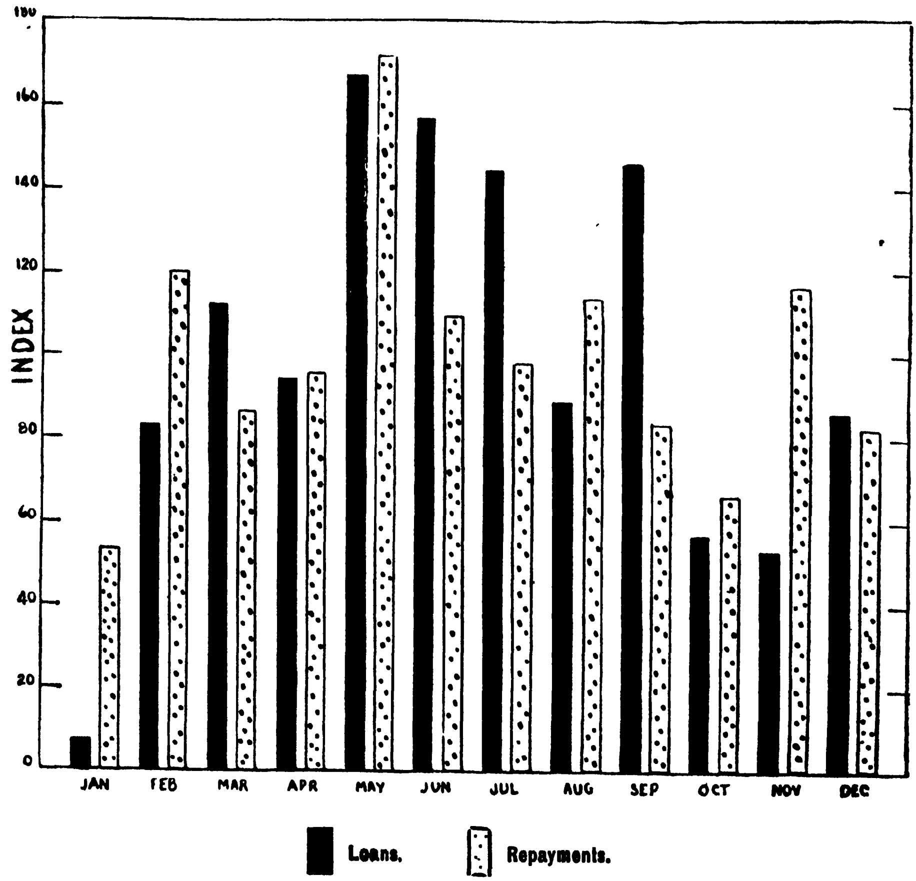

FIG. 2. In the Vergenoegen area, highest loans were taken from May to July and in September, highest repayments made in May.

all banks have taken advantage of this facility. Government loans made before March, 1932, bear interest at the rate of 5 per cent.; all subsequent loans bear interest at the rate of 6 per cent. per annum. In many instances additional funds for lending have been provided by temporary advances, bearing interest ranging from 5–7 per cent. per annum, from shareholders and sister-institutions. Short term loans were also made by the Colonial (now Barclays) Bank. One bank, the Essequibo, at one time accepted deposits repayable on demand, with interest at the rate of 5 per cent. per annum, but did not maintain the practice.

The Banks' revenue is obtained by an interest charge of 12 per cent. per annum on loans. Advances are made, only to members, on a *pro rata* basis, which, in the case of most banks, is $5.00 (loan) to $1.00 (paid up share). Loans are made only when convertible security is offered and at the discretion of the Committee of Management for "productive agricultural or industrial enterprises." Of the Committee of Management of each bank the district agricultural officer is Chairman.

The writer has for some time been engaged on the work of the Co-operative Credit Banks of West Demerara and has experienced the need for reliable information in regard to the seasonal variation in loans and repayments. The need became specially apparent when the usefulness of certain of the banks was being threatened because of a large number of long outstanding loans and when, in consequence, vigorous action was being taken to press for payment. It has become evident that if the service of these banks is to be unimpaired, a Chairman, with his Committee, must pursue a policy which ensures better loan collections than there have been in the past. There is in each bank a percentage of borrowers who do not meet their indebtedness unless forced to, and there is a larger percentage who repay their loans only after firm persuasion. It is in connection with work of this type—the formulation of a policy for increasing debt collections—that it is helpful to possess information in regard to the periods at which borrowers are best able to pay. It will be seen from the figures which follow that the seasons when repayments are made and loans taken are not the same in the several banks.

As the writer is more intimately connected with the co-operative credit work in West Demerara, the figures for loans and repayments of all banks in West Demerara have been examined, while for other districts of the Colony only representative banks have been selected. The period for which bank transactions have been studied is 1923-33 (except in the case of Ann's Grove, when the period studied is 1924-33) and the figures of each bank are discussed independently.

THE ESSEQUIBO CREDIT BANK.

This bank is located at Onderneeming and provides credit mainly to residents on the southern Essequibo coast chiefly for rice-farming. From Table 2 it can be seen that the lending business of the Essequibo bank has increased—at the rate

of 3.4 per cent. (of the average annual loans) per annum. Most loans have been made from May to July and in December with least in October and November (see Fig. 1). There has, however, been a marked downward trend in collections, the decrease being at the rate of 5.7 per cent. (of the average annual repayments) per annum. The months of highest repayments have been November and December and, to a less extent, May, June and July (see Fig. 1) with least repayments in March. Rice is the only industry of importance in the locality; it is safe to conclude that loans and repayments have been controlled by the seasons of rice production. This has been borne out by the data, the high May to July loans being taken during the rice-growing period, while November-December payments have been made from the proceeds of the Autumn crop and May-July payments from the Spring crop.

TABLE 2.

Trends in Loans and Repayments in Ten Credit Banks, (1923–33).

BANKS.	Trend in Loans. (%)	Trend in Repayments. (%)
Essequibo	+3.4	−5.7
Vergenoegen	+6.1	−0.5
Vreed-en-Hoop	−7.2	−5.8
Good Intent-Sisters	+1.7	−1.7
Canal No. 1	−1.8	+1.0
Ann's Grove-Clonbrook	−7.4	−5.6
Den Amstel-Fellowship	−7.5	−9.0
Golden Grove-Nabaclis	−1.1	+0.2
Rose Hall	−1.0	+1.2
Skeldon	+9.7	+3.7

It should be pointed out that the amounts loaned in the early years under consideration were small, due to severe losses suffered by the bank through defalcations in years immediately previous to the period being studied. The marked decrease in collections must be attributed to some extent to the depressed economic conditions in the area served by the bank.

VERGENOEGEN CREDIT BANK.

This bank is situated at Vergenoegen, West Coast, Demerara, and provides credit mainly to rice and provision farmers who also obtain part-time employment on the neighbouring sugar estates.

From Table 2 it can be seen that the lending business of the bank has increased during the period—at the rate of 6.1 per cent. (of the average total annual loans) per annum. The season during which most loans have been taken has been May to September, with a somewhat reduced demand in August (see

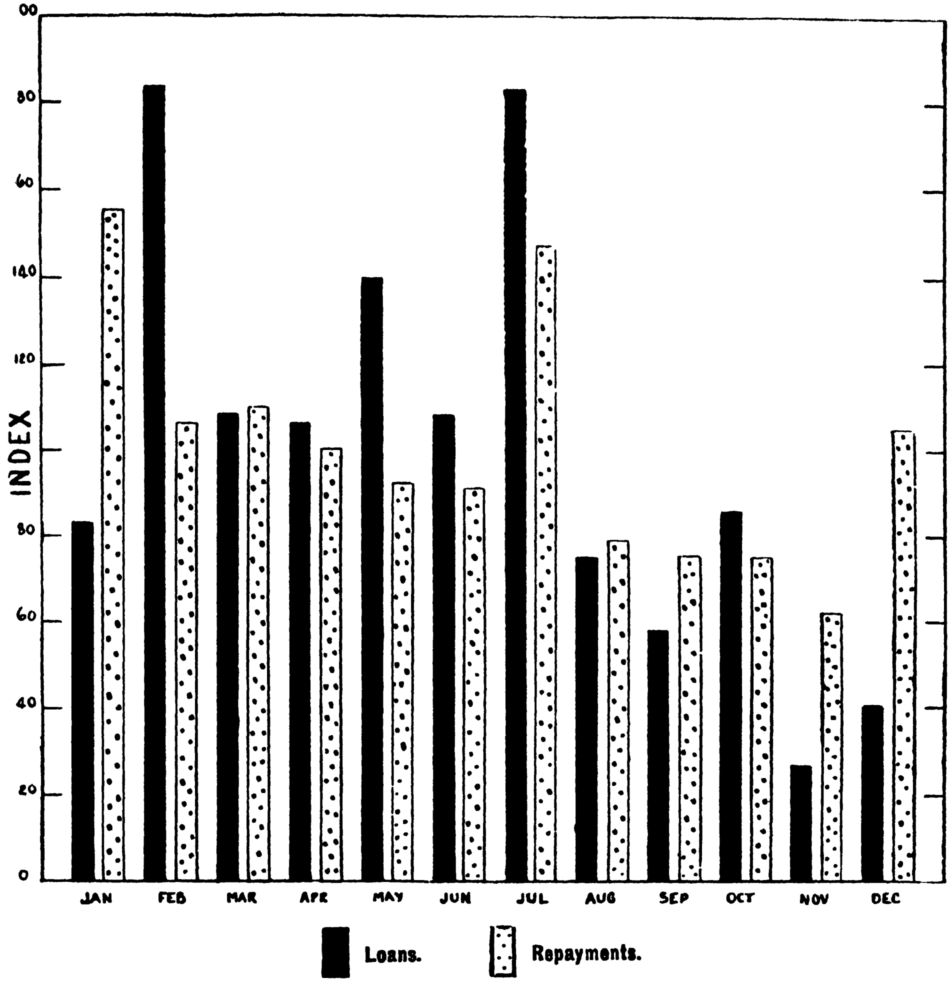

FIG. 3. In the Vreed-en-Hoop area, highest loans were taken in February, May and July, and highest repayments made in January and in July.

PLATE XXVI.

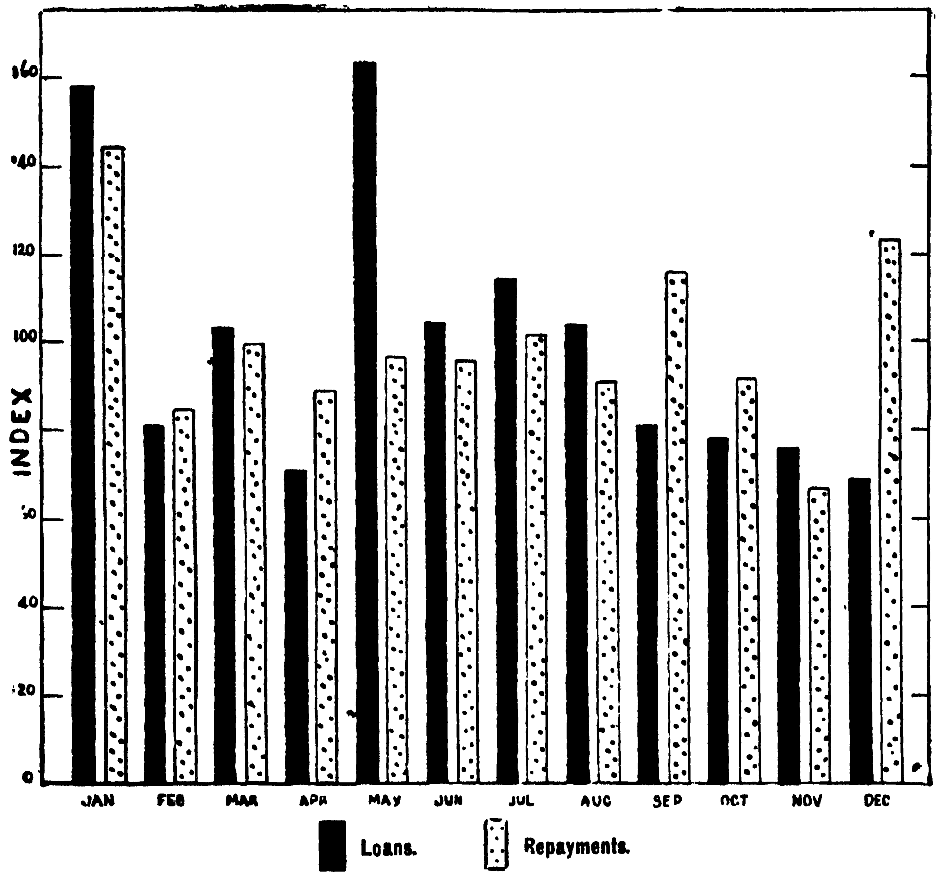

FIG. 4. In the Canal No. 1 area, highest loans were taken in January and May, and highest repayments made from December to January.

Fig. 2). There has, however, been a very slight downward trend in debt collections, a reduction at the rate of 0.5 per cent. (of the average total annual repayments) per annum. Highest repayments have been made in May ; there has been little variation in repayments made during the other months of the year (see Fig. 2).

The absence of marked seasonal variation in the transactions of this bank is attributed to the fact that most borrowers, in addition to their farming activities, obtain employment on the neighbouring sugar estates. The wages received help both to finance the production of rice as well as provision crops and to make regular repayments on loans obtained from the Credit Bank.

DEN AMSTEL-FELLOWSHIP CREDIT BANK.

This bank is situated at Den Amstel, West Coast, Demerara, and provides credit chiefly for rice and miscellaneous farming to small cultivators in the locality.

From Table 2 it can be seen that there has been a tendency for the lending business of the bank to decrease during the period, the trend being downward at the rate of 7.5 per cent. (of the average annual total loans) per annum. February, June and August have been the months during which borrowers have received highest amounts in loans : lowest amounts have been taken from September to November (see Table 3). High loans in February are attributed to the demand for credit for the rice spring crop and the June-August loans to need for credit for the rice autumn crop.

TABLE 3.

Seasonal Variation in Loans from and Repayments to the Skeldon, Den Amstel-Fellowship, Ann's Grove-Clonbrook and Good Intent-Sisters Credit Banks.

MONTHS.	SKELDON.		DEN AMSTEL-FELLOWSHIP.		ANN'S GROVE-CLONBROOK.		GOOD INTENT-SISTERS.	
	Loans. (Index).	Repayments. (Index).	Loans. (Index).	Repayments. (Index).	Loans. (Index).	Repayments. (Index).	Loans. (Index).	Repayments. (Index).
January	67.4	99.8	94.2	127.0	115.3	124.2	103.4	100.7
February	86.3	109.3	172.0	107.2	125.6	107.6	78.2	67.6
March	131.7	134.0	119.4	101.2	85.1	85.1	93.3	114 0
April	128.0	96.6	74.0	98.3	76.0	64.6	123 2	100 0
May	100.4	135.9	112.6	104.2	66.5	76.1	157.3	109.9
June	200.4	121.8	172.0	88.0	118.9	102.9	81.9	89.6
July	118.9	84.4	83.1	76.7	209.3	175.8	94 4	92.0
August	77.8	79.9	130.0	104.1	128.5	94.9	119.7	121.1
September	111.1	89.1	54.4	65.7	77.1	80.5	86.0	135.7
October	67.4	56.3	54.0	57.7	78.8	60.1	79.4	80.2
November	67.4	86.8	54.3	125.5	37.8	76.0	107.1	90.4
December	43.3	106.1	80.0	144.5	81.2	152.2	75.9	98.8

There has been a marked downward trend in repayments—a decrease at the rate of 9.0 per cent. (of the average annual total repayments) per annum. Some part of this decline in collections must be attributed to the decreasing amounts loaned. The months of highest repayments have been November to January and the lowest September to October. High repayments have been made from November to January chiefly with the proceeds of the autumn rice crop; the low September-October payments have been caused by the need for money during the cultivation and harvesting of the crop.

VREED-EN-HOOP CREDIT BANK.

This bank is situated at Pouderoyen, West Bank, Demerara, and provides credit mainly to the rice farmers in the neighbouring areas of the West Coast and the provision farmers of the lower West Bank of the Demerara river.

From table 2 it can be seen that the lending business of the bank has decreased markedly during the period, the trend being downward at the rate of 7.2 per cent. (of average total annual loans) per annum. Most loans have been taken by borrowers in the months of February and July and least in November and December (see Fig. 3).

There has been a tendency for a reduction in the annual collections of the bank, the trend being a decrease at the rate of 5.8 per cent. (of the average total annual loans) per annum. The months of highest repayments have been January and July (see Fig. 3). There is not very marked variations in other months of the year.

CANAL NO. 1 CREDIT BANK.

This bank is situated at Bagotville, West Bank, Demerara, and provides credit mainly to the farmers of No. 1 Canal, La Grange and the neighbouring villages. Many of the borrowers are also miners in the gold and diamond fields.

From table 2 it can be seen that the lending business of the bank has decreased slightly during the period, the trend being a reduction at the rate of 1.8 per cent. (of the average annual total loans) per annum. The months during which borrowers have taken the highest amounts in loans are January and May with lowest in December (see Fig. 4).

There has been a tendency for the amounts collected annually by the bank during the period to increase the trend being slightly upward at the rate of 1 per cent. (of the average annual total repayments) per annum. The months during which borrowers have made highest repayments are December and January with lowest in November (see Fig. 4).

GOOD INTENT—SISTERS CREDIT BANK.

This bank is situated at Good Intent and Sisters, West Bank, Demerara, and provides credit mainly to farmers of No. 2 Canal and of the vicinity. Many of the borrowers obtain employment on the neighbouring sugar estates.

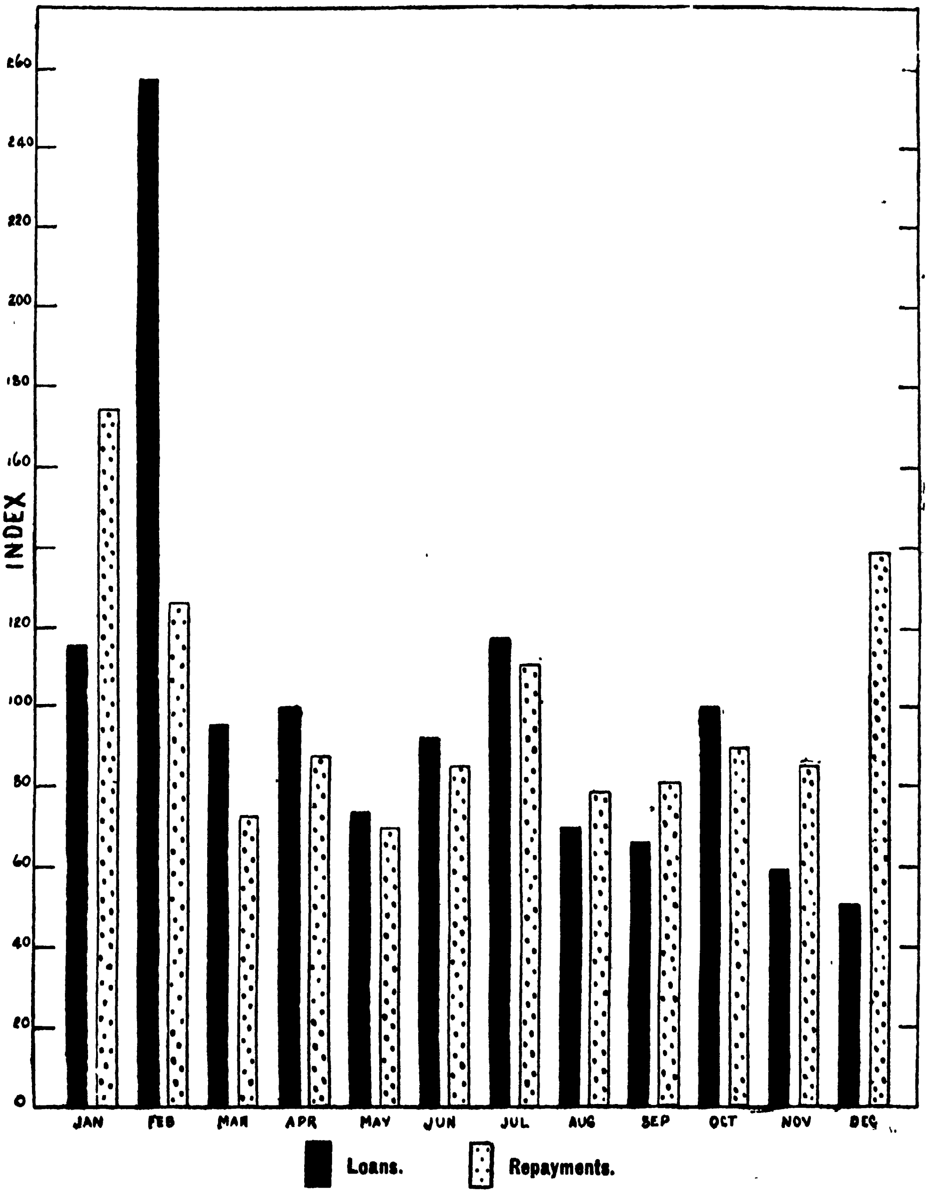

FIG. 5. In the Golden Grove—Nabaclis area, highest loans were taken in February, and highest repayments made from December to February.

PLATE XXVIII.

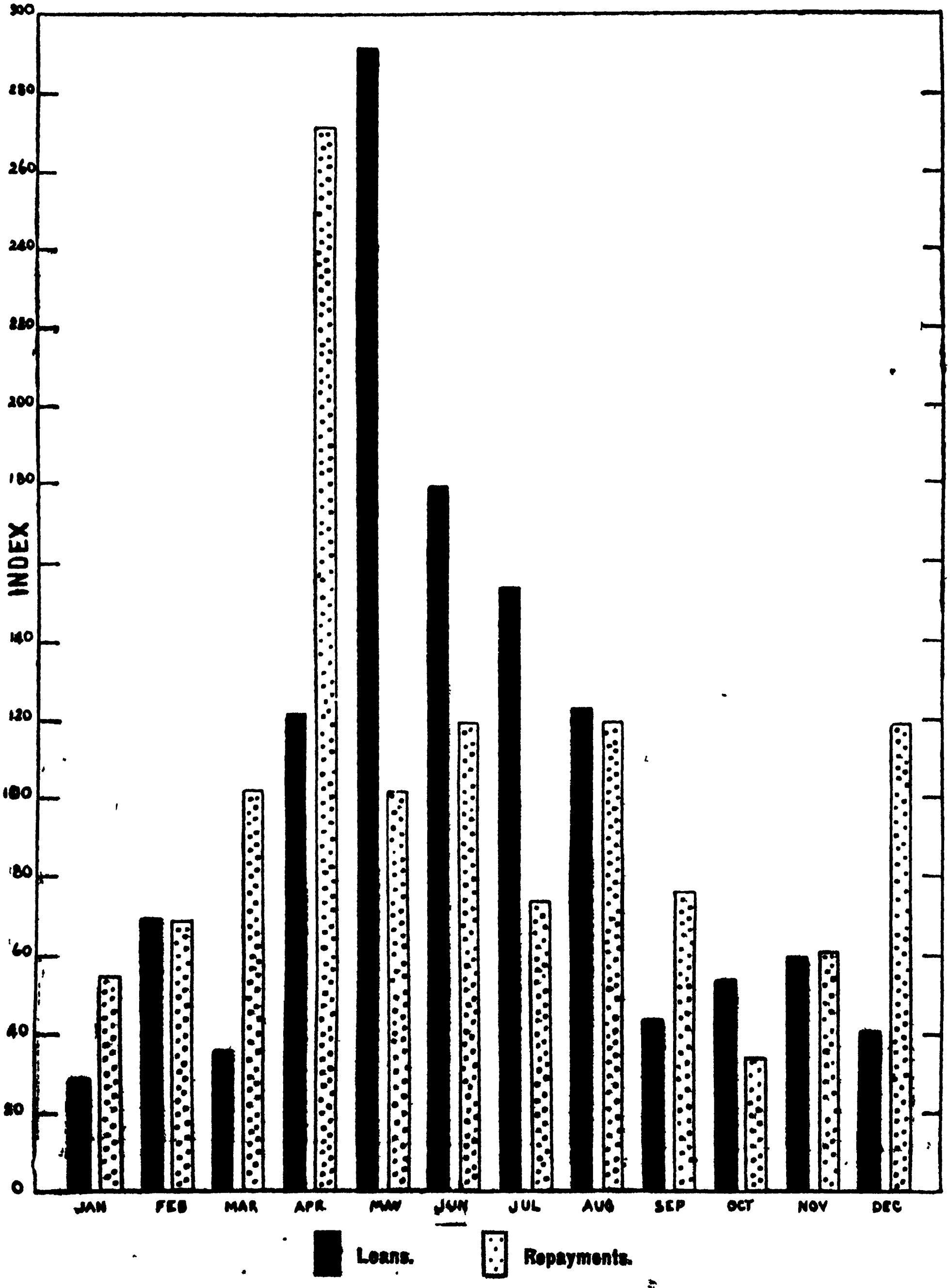

FIG. 6. In the Rose Hall (Corentyne) area, highest loans were taken from April to August, highest repayments made in April.

From table 2 it can be seen that there has been a tendency for the lending business of the bank to increase during the period, the trend being slightly upward at the rate of 1.7 per cent. (of the average annual total loans) per annum. April, May and to a lesser extent August are the months during which borrowers have on the average received the highest amounts in loans, and lowest in December and February (see Table 3).

There has been a tendency for the repayments collected annually to decrease, the trend being slightly downward at the rate of 1.7 per cent. (of the average annual total repayments) per annum. The months during which borrowers have, on the average, made highest repayments are August and September, with lowest repayments in February (see Table 3).

Golden Grove—Nabaclis Credit Bank.

This bank is situated at Nabaclis, East Coast, Demerara and provides credit mainly to coconut, provision, cane and live-stock farmers and oil makers in the locality.

From Table 2 it can be seen that there has been a tendency for the lending business of the bank to decrease, the trend being slightly downward at the rate of 1.1 per cent. (of the average annual total loans) per annum. January, February to a marked degree, and July have been the months during which borrowers have received highest amounts in loans. The smallest amounts have been taken from August to the end of the year (October being excepted, see Fig. 5). The January-February loans are attributed primarily to pig-rearing activities and to preparatory cultivation for the April-May rains.

There has been a tendency for the repayments collected annually to increase, the trend being slightly upward at the rate of 0.2 per cent. (of the average annual total repayments) per annum. The months of highest repayments have been December, January and February, with least repayments in March and May (see Fig. 5). The high repayments in December, January and February have resulted from livestock sales and sale of farmers' canes.

Ann's Grove—Clonbrook Credit Bank.

This bank is situated at Ann's Grove, East Coast, Demerara, and provides credit mainly to rice and ground provision farmers. The average borrower is a whole-time farmer, there being no neighbouring sugar estate on which part-time employment may be secured.

From Table 2 it can be seen that there has been a tendency for the lending business of the bank to decrease markedly, the trend being downward at the rate of 7.4 per cent. (of the average annual total loans) per annum. The months of highest amounts taken in loans have been June, July to a marked degree, August and February; the smallest have been taken in November and May (see Table 3). The loans in June-August have been taken mainly for rice cultivation and

purchasing of stock for ploughing, the February loans mainly by provision farmers and by miners equipping themselves for the gold and diamond fields.

There has been a tendency for the repayments collected by the bank annually to decrease, the trend being downward at the rate of 5.6 per cent. (of the average annual total repayments) per annum. The months of highest average repayments have been July, December and January, with lowest repayments in April, May, October and November (see table 3). The July repayments are attributed to the sale of provision crops and of fruits and also to the home-coming of miners from the diamond and gold fields for the August holidays; the December-January repayments to sales of the autumn rice crop. The lowest repayments have occurred during the growing period of the several crops.

ROSE HALL CREDIT BANK.

This bank is situated at Rose Hall Village, Corentyne, Berbice and provides credit mainly to rice and cane-farming residents in the area. Most borrowers obtain part-time employment on the neighbouring sugar estates.

From Table 2 it can be seen that there has been a tendency for the lending business of the bank to decrease slightly, the trend being downward at the rate of 1.0 per cent. (of the average annual total loans) per annum. May, to a marked extent, June and July have been the months during which borrowers have, on the average, received highest amounts in loans; the lowest amounts have been taken by borrowers in September, December, January and March (see Fig. 6).

There has been a tendency for repayments to increase during the period, the trend being upward at the rate of 1.2 per cent. (of the average annual total repayments) per annum. The months of highest repayments have been April, June, August and December, with lowest repayments in October, November and January (see Fig. 6).

SKELDON CREDIT BANK.

This bank is situated at Skeldon, Berbice, and provides credit for rice and miscellaneous farming to residents in the vicinity, who also obtain labour on the neighbouring sugar estates.

From Table 2, it can be seen that there has been a tendency for the lending business of the bank to increase markedly during the period, the trend being upward at the rate of 9.7 per cent. (of the average annual total loans) per annum. March, April and June, to a marked degree, have been the months during which borrowers have, on the average, received highest amounts in loans; the lowest amounts have been loaned from October to January (see Table 3).

There has been a tendency for the repayments collected annually by the bank to increase during the period, the trend being upward at the rate of 3.7 per cent. (of the average annual total repayments) per annum. The months of

highest repayments have been March to June with lowest repayments in July, August and October (see Table 3).

The Skeldon Bank has shown what may be regarded as relatively very satisfactory progress, the activity being, in comparison, greater than in the case of any of the other banks studied ; the lending business has increased by 10 and collections by 4 per cent. per annum.

SUMMARY.

In British Guiana, provision of credit, on an organized basis, is made for small farmers through a chain of district co-operative credit banks. Although each bank is an independent and self-contained unit, a co-ordination of policy is effected by an executive position being held on the committee of control of each bank by a district officer of the Agricultural Department.

The object of this study is to present in an easily available form data which are intended to be useful to Bank Committees in the organisation and planning of agricultural credit work. From an examination of the cash transactions over a series of years it has been possible to determine the seasons of the year when demands by borrowers for loans have been greatest and when least, when repayments have been highest and when lowest ; these facts have been determined in relation to 10 banks in representative agricultural districts of the Colony.

REPORTS.

LIVESTOCK PROBLEMS IN BRITISH GUIANA.

(ADDRESS DELIVERED BY PROF. THE HON. J. S. DASH, DIRECTOR OF AGRICULTURE, BEFORE THE CHAMBER OF COMMERCE, BERBICE, APRIL 5, 1935)

Mr. Chairman and Gentlemen :

I am very pleased indeed to be here to-day at the invitation of your worthy President to discuss matters pertaining to the livestock industry.

First of all, I would like to state that while the Department has done more for livestock than is generally supposed, these efforts, strictly speaking have not received the same publicity as some of its other work, for the reason that the officer in charge of the Division is not a keen writer or speaker. This officer possesses a fund of information on livestock which is best obtained when one knows him intimately and can afford the time to discuss problems quietly with him. I mention this, not as a criticism of this esteemed colleague, but only to show where there is room for improvement in the dissemination of livestock information. It is true that a large stock farm would be of great advantage educationally and I shall refer to this again. Nevertheless, there is much to be learned by frequent visits to the existing livestock unit at Georgetown.

As Director I deal with general administrative matters pertaining to stock—not details of stock management—and the only handicap which exists is a financial one. In this latter connection, I may be forgiven for saying that this is a Colony of short memories. At the time of the re-organisation of the Department there were, I think, two cows, one bull, two or three pigs, and a dilapidated shed which served to shelter them. After careful study of the whole position, I made definite recommendations to Government in Sessional Paper 16 A, 1927, outlining our requirements and proposing the establishment of a modern Stock Farm. When the estimate came up for consideration, I suggested a loan for development of these proposals. This was not favoured and, as a result, $5,000 has been voted annually from 1928, slightly increased last year to provide for a livestock centre in Leguan. With this sum, it was agreed that a start should be made with the improvement of dairy cattle, pigs and poultry.

It was considered important to begin with the dairy side for the reason that the milk supply, especially in Georgetown and for Government Institutions, was in need of improvement and as the class of people who keep milk cattle need special guidance and assistance, it was naturally felt that dairying should

receive first attention with a view to helping to solve the important problem of infant mortality, at the same time increasing the supply of fresh milk throughout the Colony generally. The Holstein-Friesian breed has proved successful in local crosses, while any progeny not suitable for breeding can, owing to their roomy bodies, be fattened more quickly than most other dairy breeds. In this connection I would remind you that the champion fat steer, at Smithfield a few years ago, was a Holstein-Friesian—a result that caused considerable consternation among breeders for beef.

Recently, Guernseys have been added to the Register as well. A careful check up in the case of one group of Holstein-Creole crosses has shown an average increase of 61 per cent. in the yield of milk over the ordinary creole cow.

The following is a brief resumé of activities of livestock improvement efforts during the period 1928-1934 :

(1.) *Cattle.*—Number of services recorded for the period—1,352. There were no services recorded in 1928, the only mature bull being at Onderneeming.

1929 ...	49	Services
1930 ...	121	,,
1931 ...	197	,,
1932 ...	245	,,
1933 ...	320	,,
1934 ...	420	,,
Total :	1,352	Services

(2.) *Swine.*—In addition to 5 boars at service, 181 breeding pigs were distributed.

(3.) *Poultry.*—Average number of pens of poultry maintained—5, while 375 head of young stock and 17,000 eggs were sold.

(4.) *Stock Register.*—The following breeding animals were sold : 4 bulls, 5 cows, 7 heifers, 2 boars, 1 sow, 1 ram and 2 ewes. The livestock in hand at the end of 1934, consisted of : 6 Holstein-Friesian bulls at stud; 4 young Holstein-Friesian bulls which will be ready for service this year (1935) ; 2 Guernsey bulls at stud; 1 Guernsey bull calf; 3 Holstein-Friesian cows; 1 Holstein-Friesian heifer calf; 1 Jack Donkey at stud; 2 working donkeys; 1 boar, 5 sows and 19 young stock—Canadian Berkshire breed—these continually increase and are disposed of as available; 6 pens of poultry (utility breeds) and 2 pens of ducks.

(5.) *Fodder Trials.*—Analyses and trials with various local fodder plants and grasses have been made while valuable grasses and plants have been introduced and established.

(6.) *General.* In 1928, there were no suitable stables for the few animals in hand. During the period 1928-1934, the following improvements were made: The land allocated for livestock was fenced and divided into paddocks. Stables were built for bulls, cows and donkeys. A piggery with portable houses and runs and other necessary equipment for open-air pig-breeding was established. A small poultry farm with portable houses and runs, incubator house and incubators, brooder house and brooders, and growing houses and chicken runs were established. A food barn with the necessary equipment for storing and grinding mash, oil engine and mill, bins, weighing machine, etc., was built.

We find it a good policy to import two young bulls almost every year; we not only get good value at reasonable cost but it is obviously a sure method of keeping up the register of stud animals where a large number of breeding females cannot be maintained. As you are aware cattle bring forth their young no more quickly and no more numerously for us than they did for Abraham; for that reason too, it is difficult to show as much progress in the same time as is the case with field crops which mature earlier and multiply more rapidly. Nevertheless, with the funds at our disposal I think it is quite clear that a good start has been made on the three classes of stock mentioned. No capital expenditure has been provided, therefore erection of stables, feed and maintenance must all come from the vote of $5,000.00.

The next step is the further development of livestock centres in the different districts following the successful start in this direction at Leguan, where the Agricultural Officer has done a great deal of educational work among the people, who are making good use of the centre. A Guernsey bull has been stationed there and a pen of poultry.

Anyone familiar with the dairy business in the Colony will appreciate the improvement which has taken place among dairy cattle, especially in those areas within relatively easy reach of Georgetown. There are large numbers of grade heifers of excellent type to be seen, with a greater appreciation of the correct methods of handling dairy animals. At the forthcoming Exhibition it is certain that those who attend will be agreeably surprised at the quality of this class of stock. The photographs exhibited give some idea of the class of breeding stock owned by the Department.

Turning to beef cattle more particularly, it is true that the same amount of progress cannot be recorded. This industry is in the hands of a more substantial class and it seems a pity that they have not been able to go in for the systematic improvement of their animals by co-operating in the importation and use of improved sires. I am fully aware of the possibilities of the beef cattle industry and its by-products.

Following on the visit of the Sugar Commission in 1930, I was asked to report on some of the points raised by the Commissioners, especially in con-

nection with the development of industries other than sugar. I then took occasion to emphasise the part that livestock development might and could play, especially on the coastlands where facilities for feeding and transport could be better organised in many respects than in the interior. Although economic conditions have changed materially since, prices have fallen and cheap food the cry everywhere, the following extract from my report at the time might be of interest :

"When all has been said and done, a careful consideration of the fact leaves "one with the conclusion (unwelcome it may be) that no crop can, at least in "anything like the near future, replace sugar or rice on our heavy coastal lands. "Apart from these two crops, our only hope lies in a well organised animal "industry, and the sooner this is realised, the better.

"The suitability of our conditions to the raising of stock is not disputed, and "markets are available at our very door. British Guiana, with a population of "300,000 imports considerable quantities of preserved meat per annum valued "roughly at 350 to 400,000 dollars. The Lesser Antilles (Dutch and American "territory excepted), with a population four times as great, can be counted on to "import three to four times as much meat as British Guiana. And further, if "and when this nearly two million dollar local and West Indian market is met, "there is always Great Britain as a possible market for frozen meat.

It is true there are drawbacks. First of all, the type of animal must be improved, pastures must be improved, since the herbage and fodder produced in this Colony are among the poorest as regards mineral content, although apparently luxuriant. On the other hand, if you drain, irrigate and condition pasture lands, it usually becomes a better economic proposition to cultivate such areas to crops so that your range livestock will always be pushed off to the poorer lands. In fact, this is what is happening in the coastal villages to-day. Then, there is fencing including provision for rotational grazing to be considered and the means of disposal of scrub animals. A fencing ordinance has been drawn up but presents a bone of contention in agricultural areas. Who is to fence? The Demerara Meat Company have made a substantial contribution to progress but I still consider that the Company have not gone far enough in the matter of by-products. I should have liked to record more developments in the manfacture of beef scrap, bone meal, fertiliser, etc., as a means of utilising poor animals. There is a potential market in the neighbouring Colonies for cheap organic fertilisers and poultry feeds and the possibilities in this direction should be further explored. The manufacture of ghee as a local minor industry might also be included.

In connection with markets for beef animals we know there are openings but at the same time I do not think the difficulties are fully appreciated. I should like to ask if many here know anything of the Venezuelan organisation in Caribbean markets. Do you know, for example, how money has been lost and can be lost in an endeavour to capture those markets? Do you know the factors operating

in this trade ? If not, I would advise close study of it before accepting the extravagant claims often made by those who are not in this business and have no intention of being in it. In saying this, I am not at all suggesting that because of difficulties little can be done. That is not my view—but what I do emphasise is that the whole of this meat trade has got to be started *on sound lines from the beginning: there can be no short cut to success.* The organised effort some time ago to put the cattle trade with Trinidad on a sounder basis was doomed to failure from the beginning because we did not have a sufficient number of the type of animal required—in other words, dependability of supply, an important factor in any trade, was lacking. The effort was premature. There are one or two dealers who have continued to make fitful exportations since and the Government Veterinary Surgeon has given advice and assisted in the selection of animals, but it is regrettable that such advice has not always been accepted.

Following on my report, just referred to, on the possibilities of livestock development, a Committee was appointed with the Colonial Secretary as Chairman to report on various questions, while the Government Veterinary Surgeon also made extended tours to the Rupununi and other outlying ranching areas. The report was published in due course and its findings are fairly well known. It contained much of interest on which work had already begun, notably with respect to pasturage and fodder plants.

Next there was a visit from Mr. Montgomery who crystallized the problems associated with the livestock industry in the West Indies region as a whole. He also stressed the need for a larger Stock Farm in this Colony. His Excellency the Governor then appointed another Committee with myself as Chairman to draw up estimates and select a suitable site for a Stock Farm. This was done, much time and study being devoted to the whole question. Plans were formulated and duly sent forward to the Secretary of State. The requirements were grouped under three heads:

(1) Stock Farm;
(2) Livestock centres;
(3) Revolving fund for the purchase and distribution, on easy terms of repayment, of beef bulls to stock owners and ranchers, pending stock farm developments.

For one reason or another, chiefly on the ground of finance—it being impossible to guarantee that a Stock Farm could be made self-supporting—the Secretary of State was unable to agree to the necessary expenditure, a fairly substantial sum. Similarly with livestock centres, it being felt in this connection that ranchers and village stock owners should take vigorous steps to co-operate with a view to self-help. Dr. Fulton stated at your last meeting that the Rupununi Company had *only imported four bulls during all these years.* I am still

hopeful that livestock centres will gradually increase in number following the success of the one at Leguan.

The Revolving Fund recommendations met with a ready response, however, and a loan of £1,500 free of interest for five years has been granted for the purpose mentioned, the animals to be purchased in the United Kingdom. Meantime, stock-owners had been circulated in regard to their requirements of any animals under this scheme and more recently I communicated with the Ministry of Agriculture, England, and suitable agents as to likely costs, etc. Including immunisation at Weybridge, purchase price, freight and all other charges, the price works out at approximately £70 per head for animals, six to nine months old. This, of course, does not cover handling charges and acclimatization for a short period at Georgetown where the animals will be under the care of the Government Veterinary Surgeon before distribution.

The breed favoured appears to be Hereford which has found its way into most parts of the Tropics, but applications have also been received for Aberdeen Angus. I had been impressed on my visit to Jamaica in 1933 with the type of Zebu developed in that Island as a useful beef animal. I saw a remarkable herd of these animals in Westmorland Parish and was shown specimens which weighed 1,000 lbs. at four years. They exhibited fine conformation for Zebus—level back and belly lines, nicely filled quarters, low set and of good type all through. On my return, I discussed with the Government Veterinary Surgeon the possibility of introducing some of these animals into this Colony as shipping facilities could be arranged by the Aluminum Line, but Major Bone did not favour the idea. First of all he does not think that additional Zebu blood is essential here and, secondly, he feared introducing a virulent strain of piroplasmosis which is believed to exist in Jamaica. These proposals were, therefore, dropped, although I still think that animals of that class would stand up exceedingly well to our conditions.

A stage has now been reached, after considerable effort, where the first step towards systematic improvement of beef animals has been taken and it is to be hoped that stockmen will avail themselves of this opportunity. Re-payments will be made as easy as possible and being on a revolving basis, the fund will be available for continued importations. The details of the scheme will be published as soon as the Legislative Council has approved of the loan in the usual way. Letters are being sent to those who had previously intimated their requirements.

Now it has been suggested in several quarters that the minimum price of local beef should be fixed or a tax levied on such beef to assist this industry. The same suggestion was put forward in connection with rice for local consumption. Unquestionably, a policy of food taxation bristles with difficulties especially during a time of depression and I should not like to express an opinion

in the matter. What I would suggest here to-day is that a strong Association of cattle owners be formed at the earliest possible date and that this Association make such recommendations and suggestions which they think fit to be considered, in the first place by the Advisory Board of Agriculture, in conjunction with a small Committee of your Association. The Department of Agriculture as a whole, the Government Veterinary Surgeon and myself personally will only be too glad to help the Association to get started. If some sort of Association already exists, strengthen and widen its scope so as to include *all* interested in livestock development.

In the matter of legislation, too, the Department has not been idle. A Bill to make provision for the improvement of the breed of cattle and other animals and with respect to the prevention of contagious and infectious diseases among them has been drafted and approved by Government for introduction in Legislative Council after it has been considered by the Board of Agriculture. It has been printed and here is a copy while copies have been sent to members of the Board. I should like to get the views of others as well and would be glad if a small Committee of say three could meet the Board when the Bill is being discussed. If your Association is formed at once, the matter would be simplified. I sincerely trust that the teeth of this Bill will not be extracted when it reaches its final stages. Among its more important provisions, some of which have been taken from existing legislation are:

Registration of Veterinary Surgeons;
Prohibition of stallions and bulls from being at large;
Conditions under which animals may be imported;
Precautions against spread of disease;

while powers are to be given to the Governor-in-Council to make regulations incidental thereto. Thus, regulations for the export and movement of animals from and in the Colony are envisaged and the question of grading animals for export might well receive attention in such regulations.

In conclusion, I should like to say a word or two in regard to control of livestock efforts. It has been laid down as a general principle that where disease is not a major factor, not necessitating a large veterinary staff—especially in Colonies of limited financial resources and where co-operation can easily be arranged between Agricultural and Veterinary Officers—that a Veterinary Division within the Department of Agriculture provides all that is required. As you are probably aware agricultural colleges have for many years been turning out men specially trained in Animal Husbandry, that is, the breeding and management of livestock—apart from the strictly veterinary side—men with animal sense and experience in stock rearing who are quite capable of giving useful service in this connection in districts to which they are attached. There are at least three agricultural officers with that training (and practical livestock experi-

ence besides) in the Department and following on the success of the livestock centre at Leguan, I am hopeful that others will gradually follow. Plans, I may say, are now in hand for one at Whim.

I thank you for the opportunity afforded me of placing livestock facts before your Chamber. I can assure you of the fullest co-operation of my Department in any measures calculated to improve livestock conditions in this Colony.

THE THIRD MEETING OF THE ADVISORY BOARD OF AGRICULTURE, JUNE 4, 1935.

PRESENT.

Director of Agriculture	....	....	....	*Chairman.*
Deputy Director of Agriculture (Ag.)		....	....	*Vice-Chairman.*
Hon. R. E. Brassington Hon. F. J. Seaford Hon. Peer Bacchus Mr. W. H. Richards Mr. R. B. Hunter	....	....	....	*Members.*

with

Mr. J. F. Irving	....	....	....	*Secretary.*

ABSENT.

Mr. J. F. Martins, from whom a letter was received expressing regret at his inability to attend, and Mr. S. Andries.

The Minutes of the last meeting which were previously circulated were confirmed.

The Secretary then read the decisions taken at the last meeting in connection with the trial shipments of bananas. The Chairman stated that it had been arranged, on the advice of the Secretary of State, for Messrs. T. & J. Harrison to make a trial shipment by their s.s. "Ingoma" due to leave this port in August. Paper sacks as used in the Gold Coast trials had been ordered from England and all expenses incurred in connection with the trial shipment would be placed to a "Suspense Account." Meanwhile, arrangements had been made with Messrs. Wieting and Richter to place a few bunches of the fruit, at different stages of maturity, in their cool rooms with a view to arriving at some idea of the best stage to cut. The Acting Deputy Director was arranging for the marking of certain bunches in the Districts which might be suitable for shipment in August. It was too early to say how many would be available. The Chairman mentioned

that the banana market at the moment appeared to be in an unsatisfactory condition, and prices would likely fall as a result of further competition. He also stated that the Department had recently planted a small acreage of bananas (Gros Michel and Dwarf) at the Experiment Station, Georgetown, on flood-fallowed clay land.

The Chairman next reported that the expenses of the Jubilee Agricultural Exhibition would fall within the figure he had originally estimated. There had been unexpected additional revenue of about $360, so that the total sum required to be found was in the vicinity of $900, which would be available from Head XXXIII.—Sub-head 17, of the Department's estimate. In this way, no additional funds would be required from the Colonial Exchequer. Members expressed their warm approval. The Chairman stated that numerous expressions of congratulation had been received; His Excellency had been pleased to express his entire satisfaction with the Show as also had the Sugar Producers' Association and the Chamber of Commerce.

The new Plant Pests and Diseases draft Bill was next discussed. The Chairman said that he was anxious to have the Bill—a copy of which had been previously sent each member for his perusal—passed through the Legislative Council at an early date. He mentioned that it had reached the Committee stage of the Council when the suggestion was made that it might be referred to the Board for their consideration. He did not think there was any justifiable cause for objection to its being passed in its present form although certain sections had been criticised as throwing too much onus on the farmer in regard to reporting pest and disease outbreaks. Mr. Boodhoo of Windsor Forest, who was present by invitation, was then asked for his views as a coconut grower on the proposed legislation. He informed the Board that he considered the Bill an excellent measure in every respect and one which was urgently required. At present there was no legislation to prevent the spread of pests and diseases. He was speaking from much previous experience; he kept his pests under control, but such was not the case on adjoining estates, where certain proprietors were not making any attempt whatever to control *Brassolis* caterpillar. He hoped that the proposed bill would soon become law. Mr. Boodhoo was thanked for attending and withdrew.

Hon. Peer Bacchus said that he considered Clauses 8 to 11 of the Ordinance rather drastic and he was not prepared to promise his support in Council. The various clauses were then fully discussed, and it appeared that misunderstanding had arisen over the question of 'notifiable' pest or disease. It was pointed out that, actually, few would come under that category locally, the most important one (on account of its habits and rapidity of spread) being the Coconut Caterpillar. The Board (Mr. Bacchus excepted) approved of the Bill, it being regarded as essential and in line with modern legislation of this kind in all countries.

In connection with the Animals (Breed and Contagious Diseases) Bill, the Chairman stated that interest was now being taken in livestock matters by the

Chamber of Commerce in Berbice, which he had recently addressed on the subject. The Chamber had been asked to appoint a Committee or Association of stockmen to consider the proposed legislation, and he was awaiting further communication from this Body.

The consideration of this Bill was deferred until a later date.

This being all the business the meeting terminated.

MEETING TO DISCUSS MATTERS CONNECTED WITH CANE-FARMING INDUSTRY AT THE CHAMBER OF COMMERCE ON APRIL 1, 1935.

PRESENT.

Hon. F. J. Seaford	President, Sugar Producers' Association
Prof. the Hon. J. S. Dash	... ... (Director of Agriculture)
Hon. J. I. D'Aguiar	(Member of Legislative Council for Central Demerara)
Mr. M. B. Laing	... ... (Commissioner, East Coast)
Mr. W. H. Richards	... ... (Manager, Pln. Lusignan)
Mr. C. H. Palmer	... (Manager, Ressouvenir Estates, Ltd.)
Mr. R. H. Payne	... ... (Manager, Pln. Enmore)
Mr. W. S. Jones	... ...(Representative, Bookers' Estates)
Mr. J. E. Wills Mr. O. Mc Garrell	Representatives from Buxton and Friendship
Mr. J. R. Straughn	Representative from Beterverwagting & Triumph

The decisions arrived at were :—

1. That a properly qualified person would be allowed in the estates' laboratories for the purpose of testing the juice when Farmers' canes were being ground ; his services to be engaged and paid for by the Cane Farmers.

2. The estates will do all they can to assist the farmers, but the estates or their authorities will not accept any liability for cut canes which had deteriorated owing to circumstances beyond Farmers' control.

3. With regard to canes from Beterverwagting and Triumph, it was agreed that Farmers would not burn earlier than Thursday night for loading on Sunday, thus allowing not more than three days to elapse between the time the canes are burnt and ground.

4. The estates also agreed to adhere to the privilege given to the Farmers of allowing them to buy—at the export price plus 75c. per 100 lbs. (Government Excise Tax)—10 lbs. of sugar made for export, for their domestic use, for every ton of cane bought.

The Meeting terminated at 3.45 p.m.

SUMMARY OF CROP REPORTS AND DEPARTMENTAL ACTIVITIES, APRIL-JUNE, 1935.

WEATHER.

The year so far has been a normal one, the dry months of the 'spring' giving place to the wet season at the end of May, which is in turn passing over to showery weather in August.

GENERAL CROP CONDITIONS.

Sugar.—Mainly on account of these favourable weather conditions, the production of sugar during the period reached 82,501 long tons. Of this, 80,675 tons were made from 26,103 Rhynland acres (equivalent to 27,640 English acres) of canes reaped on the estates, and 1,826 tons from farmers' canes purchased by the estates at a fixed minimum price.

The mean yield of sugar from estates' canes (including the smaller and less efficient properties) has been 3.08 tons per Rhynland acre compared with 2.80 tons for the spring crop of 1934 and a general average of 2.62 tons for the whole of that year. The corresponding figures per English acre are 2.94 tons, 2.72 tons and 2.49 tons respectively.

It is satisfactory to record the increased interest being shown in the growing of canes by small farmers. An indication of this is the fact that 1,826 long tons of sugar were produced during the spring crop of this year as against 2,122 tons for the whole of 1934. Government, with the assistance of the sugar estate proprietors, is endeavouring to encourage the expansion of the industry.

In connection with the activities of the Sugar Experiment Station for March to April, twelve variety experiments have been started and nine reaped, one manurial experiment started and three reaped, one flood-fallow experiment reaped. Three hundred and nineteen bags of cuttings have been distributed, thus bringing the total to two thousand two hundred and twenty-one bags for the half-year. The area in Diamond 10 and P.O.J. 2878 continues to extend rapidly and there is a steady demand for cuttings of these varieties for the East Coast (Demerara) farmers.

Sugar Bulletin No. 4 is now in the Press and will be distributed in the course of a few weeks. It discusses in detail the results of experiments reaped during the year ended June 30, 1935. As a result of these experiments, planters are advised to continue and accelerate the replacement of D. 625, D. 118, etc. by Diamond 10 and P.O.J. 2878, which are likely to add 25 per cent. to the aver-

age yield, and to make certain changes in their manurial practice which it is anticipated will lead not only to increased yields but enhanced profits.

The Amazon fly, a larval parasite of the moth-borer, has been successfully introduced and liberated on all estates. A survey of the present status of the parasite is being carried out.

In connection with aphis control, a small cane field divided into plots each with drains of different depths around it, planted in 1933 and since ratooned twice was kept under observation. No signs of aphis attack were seen. Attempts to cultivate the insect in the laboratory by the usual method of growing young cane plants in diffuse sunlight failed until the latter end of the mid-year rainy season when a mild infestation was obtained.

The price per ton for sugar for April to June has varied between $34.00 and $36.00 as compared with $35.00—$37.00 during the *same* period 1934.

Rice.—The rice exported for the first six months of the year amounted to 6,110 tons as compared with 9,761 tons in 1934 and 15,508 tons in 1933. The relatively low exports thus far in 1935 were caused by the low yields of the 1934 autumn crop brought about by prolonged dry weather. From April to June, the price for Super has remained firm at about $3.88 per bag compared with $4.25—$4.50 during the same period in 1934; the average price for lower grades has varied between $2.88 and $3.38 compared with $2.50—$3.00 during the same period in 1934.

On the whole, comparatively favourable weather conditions existed during the 1935 spring crop. The mid-year rains were somewhat late and, on this account, early sown areas suffered appreciably. Areas in which farmers "shy" usually begin operations early in the year and were the most affected. In order to enable growers to re-establish drought-stricken areas, His Excellency the Governor proposed that seed should be distributed in those areas at reduced cost. As a result, 375 bags were distributed by the Department to farmers at a cost of $1 per bag, the additional cost being borne by Government.

An extensive padi varietal programme is being conducted this year and trials have been laid down at the following centres throughout the districts:

Berbice	No. 63, Corentyne	Unirrigated land
	Pln. Ross, West Coast	do.
	Pln. Whim, Corentyne	Irrigated land.
Demerara	Pln. Hope, East Coast	do.
	Vreed-en-Hoop, West Coast	do.
	Central Rice Station, Georgetown	do.
Essequibo	Wakenaam Island	do.
	Henrietta Experimental Station	do.

It is hoped that this will become a permanent feature of the rice work as it makes possible the continual checking of the yielding power of new standard varieties under different climatic conditions. At the Georgetown Station, a large number of new varieties, including several hybrid strains, is under observation.

In addition to these trials, spacing and double transplanting experiments are being carried out at the Georgetown and Henrietta Stations, manurial trials at the Georgetown Station, and, at Henrietta, a comparison is being made between the yields of one crop and two crops per annum.

Blocks of pure line padi for distribution have been laid down at the following centres :

Berbice—Pln. Whim and Pln. Port Mourant ;

Demerara—Pln. Non Pareil, East Coast, and Vreed-en-Hoop, West Coast ;

Essequibo—Leguan, Wakenaam and Henrietta Experiment Station.

Arrangements were made by the Entomological Division with the Rice Experiment Station for small fields of padi to be planted out once a month so as to provide a regular supply of material suitable for observing the incidence of the padi stem borers *Diatraea* and *Scirpophaga* and of their parasites. Samples were taken on the average once a week and some thousands of stems examined. The figures obtained are of considerable interest and will be published in due course.

Breeding experiments with the padi bug were continued with material obtained from eggs collected at Pln. Albion in 1934. By repeated inbreeding two strains of markedly different coloration have been separated out. These are now being crossed with a view to studying the genetics of the species. Considerable work was done on the oviposition of this species.

Experiments previously laid down in connection with the control of *Calandra oryzea* L. (rice weevil) by means of calcium carbonate and sodium flour silicate were kept under observation but no further counts were made. The bionomics of a parasite *Chaetospila elegans* was studied.

Live Stock.—No further changes in the distribution of breeding bulls were made in the districts (see *Agr. Jour.* Vol. VI, 1, p. 37). The two young Holstein bulls imported last year from Canada are now being used for stud purposes, thus bringing the number of stud bulls at service at the Experimental farm to 5. There are two more young Holstein bulls that will soon be ready for service.

The Livestock entries at the Jubilee Agricultural Exhibition were very highly commended on all sides. The Department's bulls attracted much attention from the public. The Grade Holstein classes for bulls, heifers and cows were of good type and made an exhibit of a high standard. The exhibition did much to awaken the spirit of competition among live stock owners and this is to be encouraged.

The sale of young pigs has been continued and distribution has been made in the three counties.

Coconuts.—The f.o.b. price per 100 lbs. of copra during the past three months has varied between $1.87 and $2.05 as compared with $1.15—$1.23 during the same period 1934.

Coffee.—Harvesting, which has been in progress throughout this period, is now coming to a close. Farmers are handicapped by their reliance upon weather conditions for drying the crop. The average price for coffee has been $4.25 per 100 pounds as compared with $6.95 for the same period in 1934.

Cacao.—This is becoming increasingly popular in the North West District and a fair number of plants have been distributed to farmers. Trees under observation for resistance to Witchbroom disease were heavily pruned at the beginning of the wet weather.

Citrus.—The crop at Hosororo came to an end in April, having proved quite satisfactory. Since then, a quantity of budwood has been taken from selected trees to supply one or two private nurseries on the coast lands. The trees also have been given a dressing of fertilizers.

Bananas.—Experimental blocks of Dwarf and Gros Michel bananas have been established on the Georgetown Experiment Station on flood-fallowed land.

Miscellaneous.—A small area has been planted at Hosororo with the "Panama Hat" Palm, *Carludovica palmata.*

A number of seedlings of the Tung Oil tree, *Aleurites montana* and *A. Fordii*, have been sent to the station for planting.

Botanic Gardens.—During early April the Gardens were looking very beautiful; at the end of the dry weather, however, they showed the effects of lack of rain, and in the wet season not much could be done with parapets and beds. As the weather has lightened, however, planting has begun again and the general appearance of the flower garden is imposing.

In the nursery, grafting of mangoes and budding of citrus have been in progress, and a number of seedlings of new introductions are being raised for planting in the flower garden.

Beekeeping.—A Honey Booth was erected at the Jubilee Agricultural Exhibition and served a useful purpose in attracting attention to the uniform quality of Colony honey and the standardised containers in which the sweet is packed.

Reports from different parts of the Colony indicate that hives have not stored as large a quantity of honey during the first half of the year as would have been expected from the 1934 returns.

The Department's Demonstration Apiary has continued to distribute mated queens of Italian stock as well as nucleus hives to beginners.

Co-Operative Credit Banks.—The Divisional Officers have held regular monthly meetings of all Banks and the annual audit by the Registrar has been completed. In addition, the annual general meetings have been held at all Banks and reports presented to the shareholders on the results of the working of the year 1934.

NOTES.

The Tonka Bean.—Some interest has been shown lately in the Colony in the commercial possibilities of Tonka Beans. Their cultivation on the lighter soils, in addition to other crops, has been suggested as an added source of income to the farmer, and the tree is to be found wild in different parts of the Colony. This being the case, an attempt has been made to summarise such information as may be available on the subject, and the following notes have been compiled from a number of sources, the most valuable of which was a short Memorandum on the subject obtained from the Director of the Royal Botanic Gardens, Kew. Useful data too, concerning cultivation, were published in the *Proceedings of the Agricultural Society of Trinidad and Tobago* for 1932.

The greater part of the Tonka Beans of commerce comes from *Dipteryx odorata* Willd., but other species of *Dipteryx* yield coumarin as well, although there is some confusion concerning these. *Dipteryx odorata* is indigenous to S. America, and is known in the forests of Columbia, Venezuela, the Guianas and Brazil, and under a number of local names. It attains its best development in the region between the Caura and Cuchivero Rivers, tributaries of the Orinoco in Venezuela, and it is only sparingly scattered in the forests of the Guianas, and also in Trinidad. In this Colony it is found in the forests and has been reported as especially prevalent on the upper reaches of the Kaituma in the N.W.D. The tree is of compact habit, with dark green shiny leaves and pale greyish trunk and branches. It may reach a height of 150 ft., with a trunk 3 ft. or more in diameter. The timber is hard and similar to lignum vitae, which it may be used to replace. Large pink flowers form in showy terminal panicles and the fruit is an elliptical pod about 2 ins. long, containing the seed known as the "Tonka Bean". The ripe fruit is pale brownish yellow and the seed is covered by a pulp that is very attractive to bats, which in consequence do considerable damage to the crop.

The commercial value of the Tonka Bean lies in the coumarin, a crystalline substance, extracted from the seeds, and used to flavour tobacco, confectionery, cosmetics, etc., etc. The coumarin content varies from 1 to 3 per cent. or occasionally up to 10 per cent. Formerly Tonka Beans were the most important source of coumarin, but the compound is now synthesised on a large scale and synthetic material is used almost exclusively in the British perfume industry to-day. The continued demand for the Bean in future is therefore questionable.

The fruits can be gathered every year, but are more abundant in alternate years. They are not plucked, but those which mature and fall are gathered, and dried till the pulp shrivels, after which the shell can be cracked and the beans readily extracted.

The Beans are cured in Venezuela and Trinidad by macerating them for a few days in strong rum, which is finally run off, and the beans dried and packed for export. The crystals of coumarin can be seen on the surface of the cured beans.

The greater part of the world's supply of Tonka Beans comes from Venezuela, but a certain quantity of the Venezuelan Beans are cured in Trinidad. The Bean does not appear to have been cultivated to any extent in the past, but recently local cultivation has been encouraged in Trinidad. The tree grows there readily on sandy areas, having a long tap root, and planting is carried out either from nurseries, or direct, 'at stake'. About 50 trees are planted to an acre, care being needed during the first four or five years to keep them clear of weeds. The trees bear when 7—15 years of age, depending on the environment, and the average yield of a full grown tree is about 10 lbs. of 'beans', though in other countries it is reported as double this amount. Fruiting, however, is irregular, and the yield of individual trees varies considerably. The 'beans' may fetch 75c.—$1.00 per lb. but prices are subject to fluctuation. The greater part of the Trinidad exports are to the United States of America, smaller quantities going to Great Britain, Canada, Holland and Germany.

Natural coumarin is used for several purposes by the natives of the countries where the tree is indigenous, not only for perfumery, but to fight insects of varying kind. In Brazil, *Dipteryx odorata* has been largely destroyed, as a timber tree, and the coumarin is obtained from two smaller species, *D. polyphylla* Hub. and *D. speciosa Ducke*, the seeds of which, however, contain a smaller percentage of the product than those of *D. odorata.*

The highest quality beans from *D. Odorata* are slender, long and shining and are marketed as "Angostura" variety. The "Para" variety, from *D. Oppositifolia* Willd. Are short and small, and another variety which are grey and large, are classed as "Surinam".

Comparative analysis of samples of local beans with those grown in Trinidad show the indigenous beans to be smaller and to contain slightly over 2% of coumarin, which is about half the percentage found in the Trinidad beans. In this respect the local beans resemble those from Venezuela. As all these varieties of beans apparently come from *D. Odorata*, the explanation of the difference in coumarin content is a matter for speculation.

E. B. M.

Cultivation of Avocado Pears.—The growing of avocados is the principal horticultural industry of southern Florida, and a very interesting Bulletin (No. 272) covering the whole range of the subject has recently been issued by the University of Florida Agricultural Experiment Station, Gainesville, Florida.

This Bulletin draws attention to the extensive use of the avocado as a food crop in Central America, and of its gradual introduction into the U.S.A., first as a luxury crop, but now becoming gradually known to a wider public.

Its history, uses, and distribution, and the factors controlling the latter are recounted, and, in this connection, reference to the extreme intolerance of the avocado to standing water and 'wet feet' should be especially noted by local cultivators, many of whom will doubtless remember the heavy losses, particularly of young trees, during the floods of last year.

A technical section deals with the Botany of the avocado, and the different varieties under cultivation. There are three main races, The West Indian, the Guatemalan and the Mexican, but the many varieties known include an enormous number of hybrids between these. A number of the best known varieties are described in detail, and the results of analyses of their fruits, given in the form of tables, indicate the relative proportions of stone, flesh, skin, water content, etc., in each.

The avocado flower possesses some peculiar features, which have considerable bearing on fruit production. The flowers normally are perfect, and each produces pollen and can also develop subsequently into a fruit, but individual flowers do not shed pollen when their stigmas are receptive, and all flowers open on all trees of any one variety are in the same condition at the same time. The flowers are at first only female and then only male in function, and this is simultaneously true of all trees of the same variety. On the other hand, when trees of one variety are acting as females, those of another variety may be acting as males. Therefore, when planting, trees of two or more varieties should be together, to ensure pollination taking place.

Research has revealed that there are two classes of trees—A and B. In the former, flowers open in the morning, functioning as females, but shed no pollen. These same flowers then open on the afternoon of the following day as males, and shed pollen. In Class B, the flowers open as females in the afternoon, and then on the following morning, as males. Sometimes though, flower behaviour is erratic, enabling a certain amount of self-pollination to take place. It is however advisable, in order to ensure the maximum opportunity for pollination, that trees of both A and B varieties should be included in the same orchard, although reciprocating varieties need not be closer than three or four rows.

Detailed descriptions are given of the most effective means of propagation. Cuttings are difficult to root (attempts have been made, without success, in the Solar Propagator in the Botanic Gardens' Nursery, Georgetown), and the most effective methods of propagation are by budding and grafting. When budding, the method employed is the shield bud, similar to that used for citrus, but grafting has proved easier and more effective, and is now generally in vogue. Side-

grafting is the most popular practice in Florida. The grafting of shoots on to freshly germinated seedlings, which has been practised successfully in our nurseries, has the disadvantage that weak stocks cannot be discarded, as their character has not had time to develop when the graft is made. A full account follows of the methods employed in top working old trees of inferior type, with scions of better variety, and the method of cleft grafting employed gives very good results. There are large numbers of seedling pear trees grown locally which are of an inferior nature, but which could readily be topworked with a good variety and thereby made to yield better quality fruit.

After dealing with the best methods of lay-out for the large orchards cultivated in Florida, reference is made to the crop, and the best methods of picking and marketing. Good trees should not be allowed to develop too many fruits. Heavy and light crops usually alternate, and the fruits on heavily laden trees should be thinned out when the fruit is about an inch in diameter. Any blemished fruit should of course be removed.

The last part of the bulletin describes the major diseases and pests, and methods for their control.

Avocados can readily be grown in this Colony, and a much higher standard of fruit than that usually obtainable could very easily be produced by private enterprise. The question of exporting fruit can hardly be considered at present, but there is room for great improvement in the types generally to be obtained locally. The Department of Agriculture has a number of varieties growing in their experimental orchard at Hosororo, North West District, which include several well-known types, such as Trapp, Pollock, Galvana, Nimlioh, Fuerte and Rudder, a number of Trinidad varieties, such as St. Anne's, St. Clair, and River, and some local varieties, budded from seedlings of especially good quality, and named R. C. Lord, Martin-Sperry and Munis, after the owners of the gardens from which they originated.

These local varieties, especially the R. C. Lord, are very promising and are doing better at Hosororo than the introduced ones. Budded and grafted pears can be ordered from the Botanic Gardens, and topworking could easily be carried out by owners of poor trees in their own gardens. There is no reason why local pears should not show an increase both in quantity and quality.

E. B. M.

Fresh Milk or Condensed Milk?—The following figures in connection with the consumption of condensed milk in the Colony should be of general interest:

IMPORTATION OF CONDENSED MILK 1930–1934.

Year.	Milk lbs.	Value $
1930	685,174	91,145
1931	578,594	72,431
1932	645,584	72,080
1933	704,573	64,685
1934	1,104,482	95,388

Imports in 1934 were abnormally high through flood damage, and hence the average for the four years, 1930–1933, might in consequence be taken as a fairly reliable indication of the Colony's condensed milk consumption. Average imports for 1930–1933 were 653,481 lbs. at a cost of $75,085.

The following are figures on which estimates can be based if an effort is to be made to supplant these imports with a local supply of fresh milk :

The average annual production of a Grade Holstein is 5,500 lb ; it would therefore need 119 grade cows to supply the quantity at present imported. Further, about 37 additional cows would be required to supply milk for the 119 calves ; the number of cows required theoretically, therefore, is approximately 156, but in practice, this would have to be increased by about 50 per cent. to make provision for death, sickness and breeding irregularities. This brings the total to about 234.

If the local pen system is used, the average size of herd per owner is ten cows. It would therefore require twenty-four additional small dairymen with one assistant each to produce the milk required to supplant condensed milk imports.

H.A.F.

Fruit.—The first number of the *West Indian Fruit and Vegetable Bulletin* was issued in May, 1935. The need for the extension of production and marketing investigations by Government Departments of Agriculture was urged at the West Indian Inter-Colonial Fruit and Vegetable Conference held in Jamaica 1933. The Bulletin which is for official use only is intended to meet this need and has as its main object the early presentation of reports of progress made. The information contained in the first number and in issues which will appear from time to time on Crop Data, Field Experiments, Low Temperature work, Technical Aspects of Marketing cannot but be of use to Agricultural Departments, in the Caribbean especially, concerned in Fruit production and export.

REVIEW.

DISEASES OF THE BANANA AND OF THE MANILA HEMP PLANT

BY

C. W. WARDLAW, Ph.D.

The banana, which from time immemorial has been a staple food crop of the Tropics, has in the last 30 years become one of the most important fruits consumed in temperate and cold climates. Cheap, easy to eat, and available at all seasons of the year, its consumption is world wide.

As so often occurs in such cases, increased demand, cultivation on a vast scale, and shipment of fruit from one part of the world to another, in which the market depends largely on artificial ripening and final appearance, has brought into prominence a number of diseases of the banana and its parent plant which were formerly of little importance. A few of these diseases, both in the field and later during shipment, have assumed such proportions as to cause very serious losses, and in consequence a considerable amount of research, aimed at combating them, has been carried out in recent years.

Perhaps the most serious and certainly the best known disease of bananas in the Western Hemisphere is the Panama or Wilt-Disease, and some 6 years ago Dr. Wardlaw was selected by the Empire Marketing Board to investigate this disease in the Caribbean area, making the Imperial College of Tropical Agriculture his headquarters, and at the same time studying diseases of the fruit in storage.

In the course of this work in Trinidad and his travels in banana growing countries, Dr. Wardlaw has had unrivalled opportunity to become very closely acquainted with every aspect of banana cultivation and of the various diseases affecting it, and having been in constant touch with workers in other parts of the world, has been enabled to obtain detailed knowledge of those diseases of which he lacked personal experience. He was therefore exceptionally qualified to write a comprehensive account of our present knowledge of banana diseases, and this task he has carried out most ably. His comprehensive book, which is a model of its kind, will no doubt remain the standard work on banana diseases for many years.

The book starts with a short account of the general methods of banana cultivation, after which all the known diseases of the banana, and also of the

closely allied Manila Hemp plant, are dealt with in turn. The volume is divided into 4 sections, covering Soil Borne, Vascular and Stem Diseases; Plantation Diseases of Fruit and Leaf Diseases; Virus Diseases; Storage Diseases. Detailed descriptions of the causes, symptoms, related factors and methods of control are given, the major diseases, such as Banana Wilt and Bunchy Top, on which considerable research has been carried out, being dealt with most extensively. The book is very fully illustrated, the majority of the figures and plates being of a high standard. Further relevant details, such as a list of bacteria and fungi associated with the banana, and data concerning the shipping of the fruit, are contained in appendices. A very complete list of references to the literature of the subject completes the work.

A book such as this is an encyclopædia of information to the research worker, summing up all that is known on the subject at present, and indicating the lines on which further investigation is needed. The very clear descriptions and illustrations of the diseases should be of great help to the planter or agricultural officer, enabling him to identify them and indicating the lines to be followed in their remedy and control. Finally, the book should prove a source of valuable information to those concerned with the shipping and marketing of the banana after it leaves the field.

The book, published by Macmillan & Co., Ltd., 8vo., 627 pages, costs 30/- net.

E. B. M.

NEWS.

The Director of Agriculture visited Berbice from April 4 to 6 and *inter alia* addressed the Berbice Chamber of Commerce and Development Association on April 5, on "Livestock Problems." The text of this address is published elsewhere in this issue. The Chamber has been pleased to appoint Professor Dash an honorary member.

His Excellency the Governor, Sir Geoffry Northcote, K.C.M.G., visited the Head Office and the various Experiment Stations and Nurseries on April 16, 1935.

The Director of Agriculture, Professor the Honourable J. S. Dash, and his daughter, Miss P. Dash (in the absence in Barbados of Mrs. Dash) were "At Home" to the members of the staff on Tuesday afternoon, April 30.

His Excellency the Governor, accompanied by the Director of Agriculture, visited the Essequibo District from July 16 to 20 on a tour of inspection.

The Essequibo Commission of which the Director of Agriculture is Chairman, submitted their report, which was unanimously signed, to Government on July 8.

Consequent on the absence from the Colony of Mr. F. Burnett, Deputy Director and Secretary of the Commission, Mr. H. D. Huggins, Agricultural Superintendent, was appointed Secretary as from May 22, 1935.

Mr. J. Fergus Grant, representative of the "*Montreal Gazette*", visited the Head Office and Experiment Stations on July 18. Photographs of interest and printed reports that might be useful were placed at Mr. Grant's disposal by the Department.

Mr. F. A. Barnes, His Majesty's Trade Commissioner (acting) for the Eastern Group of the West Indies—Trinidad, Barbados, Leeward and Windward Islands—Bermuda and British Guiana, visited the Department on July 9.

Professor Dash was absent from May 8 to 21 on a visit to the neighbouring Colonies.

The Deputy Director of Agriculture, Mr. F. Burnett, proceeded to England on vacational leave on May 18, 1935. Mr. E. M. Peterkin, Agricultural Superintendent, East Demerara, has been appointed to act as Deputy Director.

Mr. D. D. Blackman, Meteorological Observer, returned on June 28 from vacational leave, which was spent in the West Indies.

Major T. Bone, Government Veterinary Surgeon, returned from vacational leave on July 23. Mr. H. A. Fraser, B.V.Sc., acted as Government Veterinary Surgeon during this period.

Miss V. Chan Choong, Librarian, returned on July 27 from vacational leave, which was spent in the West Indies.

Mr E. M. Morgan, Agricultural Instructor, is scheduled to leave on August 13 on six months' vacational leave for Tuskegee, Ala., U.S.A., where he plans to take a short course of study.

PLANT AND SEED IMPORTATION.

Introductions by the Department of Agriculture for the period ending June, 1935.

Name	Quantity	Whence Supplied
Economic.		
Vegetable seeds	10 ozs.	Messrs. Peter Henderson & Co., U.S.A.
do.	54 ozs.	Messrs. Sutton & Sons, England.
Tomato (Bonny Best)	3 ozs.	Messrs. Peter Henderson & Co., U.S.A.
Papaw—4 varieties	1 packet each	Agric. Officer, Br. Honduras, St. Augustine Nursery, Trinidad
Pigeon Peas—3 varieties	1 packet each	Nagpur, India.
White Pigeon Peas White Cowpea	1 packet each	Imp. College, Trinidad.
Soya Bean—4 varieties	4 packets	Central Exptl. Farm, Ottawa.
Pomegranate—5 varieties	28 cuttings	Dept. of Agric. & Forests, Palestine.
Passiflora ligularis	1 packet	Dr. W. A. Archer, Caracas, Venezuela.
Passiflora antioquensis	1 packet	Dr. W. A. Archer, Bogota, Colombia.
,, sp.	3 packets	
,, sp. anolaima	1 packet	
Ornamental.		
Barnadesia sp.	1 packet	Dr. W. A. Archer, Bogota, Columbia.
Lantana sp.	1 packet	
Ornamental plants, etc.,	19 packets	U.S Department of Agric., Washington, D.C.
Assorted Palm Seeds	4 packets	Coconut Grove, Palmetum, Florida.
,, ,, ,,	10 packets	David Barry, Los Angeles.
Assorted Flower Seeds	26 packets	Messrs. Peter Henderson & Co., U.S.A.
,, ,, ,,	70 packets	W. G. Hastings & Co., Atlanta.
,, ,, ,,	183 packets	Messrs. Sutton & Sons, England.
Arrabidaea sp.	1 packet	Dr. W. A. Archer, Caracas, Venezuela.
Miscellaneous seeds	93 packets	La Mortola Gardens, Ventimiglia, Italy.
Chrysanthemum	33 cuttings	Central Exptl. Farm, Ottawa.
Violet Tree (*Phlebotaenia cowellii*)	2 plants	Puerto Rico Agric. Exp. Station, Mayaguez.

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the agricultural and forest products of the Colony exported for the first three months during 1935.

The corresponding figures for the same period during previous years and the average for the 17 years prior to that are added for convenience of comparison.

Product		*Average 1916-32*	*1933*	*1934*	*1935*
Sugar	tons	20,196	40,464	36,796	34,169
Rum	proof gallons	576,586	269,601	155,651	282,090
Molasses	gallons	371,301	1,982,394	1,570,859	1,703,812
Molascuit	tons	365	52	nil	20
Rice	tons	3,565	7,582	6,445	3,656
Coconuts	thousands	515	151	293	417
Coconut Oil	gallons	6,438	3,539	3,621	3,529
Copra	cwts.	6,530	7,040	2,000	12,590
Coffee	cwts.	2,205	3,920	2,800	1,021
Lime Juice Concentrated	gallons	250	nil	nil	nil
Essential Oil of Limes	gallons	20	138	nil	208
Rubber	cwts.	36	nil	nil	nil
Balata	cwts.	2,017	183	38	929
Gums	lbs.	786	nil	nil	nil
Firewood—Wallaba, etc.	tons	2,260	3,839	3,819	2,679
Charcoal	bags	11,982	16,146	16,686	15,360
Railway sleepers	No.	4,600	300	3,567	2,778
Shingles	thousands	429	151	197	82
Lumber	ft.	50,858	45,636	30,125	91,714
Timber	cu. ft.	36,567	56,645	51,570	42,268
Cattle	head	112	1	113	146
Hides	No.	1,685	1,592	1,815	2,689
Pigs	No.	123	82	53	97
Sheep	No.	5	nil	nil	nil

EXPORTS OF AGRICULTURAL AND FOREST PRODUCTS.

Below will be found a list of the agricultural and forest products of the Colony exported for the first six months during 1935.

The corresponding figures for the same period during previous years and the average for the 17 years prior to that are added for convenience of comparison.

Product		*Average 1916-32*	*1933*	*1934*	*1935*
Sugar	tons	44,765	65,491	79,396	83,606
Rum	proof gallons	995,109	379,123	420,795	567,024
Molasses	gallons	896,106	4,859,617	3,553,246	1,980,961
Molascuit	tons	552	77	nil	105
Rice	tons	6,443	15,693	9,777	6,110
Coconuts	thousands	866	356	1,031	1,116
Coconut Oil	gallons	11,957	7,599	6,425	4,300
Copra	cwts.	11,442	15,451	2,000	17,480
Coffee	cwts.	3,839	6,754	4,012	2,261
Lime Juice Concentrated	gallons	3,341	nil	2,165	nil
Essential Oil of Limes	gallons	180	518	288	245
Rubber	cwts.	51	nil	nil	nil
Balata	cwts.	2,928	3,881	1,029	1,441
Gums	lbs.	1,060	nil	nil	nil
Firewood—Wallaba, etc.	tons	4,615	7,362	5,069	5,730
Charcoal	bags	23,378	30,388	32,892	31,679
Railway sleepers	No.	6,832	3,035	4,567	9,149
Shingles	thousands	944	508	318	292
Lumber	ft.	81,761	96,592	53,624	184,182
Timber	cu. ft.	80,847	107,703	99,843	85,472
Cattle	head	226	76	242	340
Hides	No.	3,048	2,872	2,725	6,406
Pigs	No.	225	82	322	310
Sheep	No.	16	nil	nil	nil

CURRENT PRICES OF COLONIAL PRODUCE.

From The Commercial Review, Journal of the Georgetown Chamber of Commerce, Vol. XVIII, No. 13, July, 1935.

SUGAR.

Per 100 lbs. net   3 lbs. per Bag allowed for tare

Dark Crystals for Local Consumption..........$3.30
Yellow Crystals do. do. $4.00
White Crystals..........$4.75
Molasses Sugar..........none offering.

Above Prices include Excise Tax $75.

RUM.

Imperial Gallon.   Cask included.

Coloured, in Puncheons—40 to 42 O.P...(for export)...60c.; Hhds. 52c.; Barrels 77c.
White, in Hogsheads—10 to 45 O.P...(for local consumption)..........45 to 55c.

MOLASSES.

Per Imperial Gallon.   Naked.

Yellow (firsts)..........10c.
Yellow (seconds)..........$5\frac{1}{2}$c.

RICE.

Rice..........per Bag of 180 lbs. gross, Brown Super $3.75 to $4.00; No. 1, $3.25—$3.50; White $3.75 to $4.00 as to quality. Lower Grades $3.25—$3.50
Paddy..........per Bag of 143 lbs. gross, $1.50 to $1.75

GENERAL.

Timber, Greenheart, (Lower grade measurements)...40c. to 60c. per c. ft.; for export 72c. to $1.00 per c. ft.
do. Railroad Sleepers—(Mora)..........$1.68 each
Greenheart Lumber..........$60 to $70 per 1,000 feet.
Crabwood Lumber..........$60 to $75 per 1,000 feet.
Shingles, Wallaba, 4 x 20 and 5 x 22 inches,..........$3.50 to $5.50 per M.
Charcoal, Capped for shipment..........72c. to 85c. per bag.
Firewood..........$2.16 to $2.50 per ton.
Coconuts...Selects, $9.00, culls.. $6.00 M...Copra $2.00 per 100 lbs.—Prime Copra.
Balata..........Venezuelan, none. Local Sheet...36c. to 38c. per lb.
Cocoa..........19c. to $19\frac{1}{2}$c. „ „
Coffee..........$4\frac{3}{4}$c. to 5c. „ „

N.B.—Duty on Payable value at time of Importation and rate of exchange on day of arrival.

METEOROLOGIAL DATA—JANUARY TO MARCH, 1935.

Recording Stations & Months.	Rain-fall.	NUMBER OF DAYS OF RAIN						Evaporation	Air Temperature and Humidity.			
	Total Inches.	Under ·10 Inch	·10 to ·50 Inch	·50 to 1·00 Inch	1·00 Inch to 2·00 Inches	Above 2·00 Inches	Total days.	Inches	Maximum.	Minimum.	Mean.	Humidity of Mean.
Botanic Gardens.												
January ...	5·94	4	5	...	...	2	11	4·55	83·9	75·9	79·9	81·2
February ...	10·59	2	10	2	4	...	18	4·26	83·6	74·8	79·2	81·6
March ...	3·72	7	7	1	1	...	16	5·65	84·1	75·9	80·0	80·2
Totals	20·25	13	22	3	5	2	45	14·46				
Means.	...	...	...	...	...	...	...	...	83·9	75·5	79·7	81·0
Berbice Gardens.												
January ...	3·96	...	9	1	1	...	11	...	85·8	73·4	79·6	79·3
February ...	17·88	...	3	1	5	1	10	...	84·4	73·5	78·9	84·2
March ...	1·20	4	5	...	...	...	9	...	85·3	74·9	80·1	75·2
Totals	23·04	4	17	2	6	1	30	...				
Means.	...	...	...	...	...	...	...	...	85·2	73·9	79·5	79·6
Onderneeming												
January ...	6·50	...	8	1	1	1	11	...	89·2	72·9	81·0	87·9
February ...	19·64	1	4	5	1	5	16	...	92·2	72·4	82·3	88·4
March ...	5·15	1	8	3	1	...	13	...	89·2	73·5	81·3	87·4
Totals	31·29	2	20	9	3	6	40	...				
Means.	...	...	...	...	...	...	...	...	90·2	72·9	81·5	87·9
Hosororo, North West District												
January ...	2·61	5	6	1	...	...	12	...	86·3	67·1	76·7	81·0
February ...	5·88	7	4	4	2	...	17	...	86·6	66·2	76·4	80·7
March ...	6·41	10	5	4	1	...	20	...	87·3	67·2	77·2	80·2
Totals	14·90	22	15	9	3	...	49	...	...	...	...	...
Means.	...	...	...	...	...	...	...	...	86·7	66·8	76·8	80.6

METEOROLOGIAL DATA—APRIL TO JUNE, 1935.

Recording Stations & Months.	Rain-fall.	NUMBER OF DAYS OF RAIN						Evaporation	Air Temperature and Humidity.			
	Total Inches.	Under ·10 Inch	·10 to ·50 Inch	·50 to 1·00 Inch	1·00 Inch to 2·00 Inches	Above 2·00 Inches	Total days.	Inches	Maximum.	Minimum.	Mean.	Humidity Mean.
Botanic Gardens.												
April ...	1·15	3	6	...	...	...	9	5·90	85·1	75·9	80·5	76·8
May ...	11·56	4	6	3	2	2	17	4·93	85·4	76·3	80·8	80·2
June ...	14·37	7	15	3	3	1	29	3·36	84.0	75·5	79·7	86·2
Totals	2·708	14	27	6	5	3	55	14·19				
Means.	...	...	...	...	...	...	...	...	84·8	75·9	8·03	81·1
Berbice Gardens.												
April ...	1·33	2	6	...	...	...	8	...	85·4	75·0	80·2	...
May ...	9·86	2	5	2	4	1	14	...	86·8	75·5	81·1	...
June ...	18·31	...	10	5	5	3	23	...	85·6	75·2	80·4	...
Totals	29·50	4	21	7	9	4	45	...				
Means.	...	...	...	...	...	...	...	...	85·9	75·2	80·6	...
Onderneeming												
April ...	1·83	...	3	2	...	...	5	...	89·9	73·5	81·7	...
May ...	12·91	...	5	4	4	1	14	...	99·3	73·2	81·2	...
June ...	20·88	1	15	5	6	2	29	...	88·9	72·8	80·8	...
Totals	35·62	1	23	11	10	3	48	...				
Means.	...	...	...	...	...	...	...	...	89·4	73·2	81·2	...
Hosororo, North West District												
April ...	1·89	7	4	1	...	...	12	...	90·3	66·8	78·5	...
May ...	8·50	6	8	3	3	...	20	...	89·2	64·6	76·9	...
June ...	13·02	4	11	10	1	1	27	...	88·0	67·4	77·7	...
Totals	23·41	17	23	14	4	1	59	...	...	...	...	...
Means.	...	...	...	...	...	...	...	...	89·2	66·3	7·77	...

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CONTENTS.

(Vol. VI, No. 4.)

The

Agricultural Journal of British Guiana.

December, 1935.

EDITORIAL.

FRUIT.

'Eat More Fruit'—the phrase has become a by-word and a subject for music hall jokes, and yet not so very long ago fruit in temperate and cold climates was considered, among town dwellers at any rate, as a luxury; to be consumed in small quantities, to form the '*bonne bouche*' of a meal, or to be the diet of invalids and convalescents. The indigenous fruits were only obtainable during part of the year, and the season for each of these was short lived. Apples alone lent themselves to storage for any length of time, and during the winter, fruit could only be partaken of in the form of jams and preserves by those who had sugar enough to make them. 'Hot house' fruits of semi-tropic countries were limited to the rich. Tropical fruits were savoured chiefly in the reminiscences of travellers, or very rarely procured, at great trouble and expense, to grace the boards of the fortunate few who could obtain them.

In the tropics on the other hand fruit grew abundantly, and was looked upon as a gift of nature to be accepted as a matter of course. A sufficiency for the needs of the individual was always at hand, obtained with a minimum of trouble. The quantity was ample, the quality of little or no concern.

As means of communication improved, however, and transport became more rapid, the commercial possibilities of exotic fruits in northern markets began to be realised. Towards the latter part of last century such fruits as oranges and bananas were shipped in small quantities, and commanded high prices on the market, where they were regarded as a speciality.

With the advent of cold storage methods at the beginning of the present century, enabling perishable fruits to undergo lengthy journeys and be ripened on arrival, so that the citizens of temperate climates could enjoy fruits from all parts of the world, fruit began to be an important constituent of the world's markets.

The first tropical fruit to be marketed on a large scale was the banana, which produced fruit throughout the year. While the Cavendish variety—at its best in the sub-tropics—found its way to Europe from the Canaries packed in cotton wool, brown paper and crates, the Gros Michel proved much better suited to long distance transport. The history of the organisation that has been built up to handle this crop, grown on ever spreading areas, so that it is available today even to the poorest in all countries

of the world and at all seasons, is a remarkable story. But not only tropical fruit benefited by cold storage, the apples of temperate climates and the citrus fruits of semi-tropical lands became marketable products for which there was an enormous demand in Europe and North America, and which could be supplied, from different parts of the world, thoughout the year.

As the market for fruits developed, it was realised that by proper advertisement a public could be brought to know and demand a fruit which but a few years previously had been unheard of by them. An instance of this is the grape-fruit, the increased demand for which within a very few years was remarkable. To-day, tentative attempts are being made to ship such delicate fruits as the mango and avocado pear to the North. Should these prove successful, it will remain to create a demand for these among people who at present do not know what they are or how to eat them.

Side by side with the preservation of fresh fruit at low temperatures the canning industry has also advanced. Hitherto the pineapple has been the only tropical fruit to be marketed in large quantity by this method, but other fruits are now proving themselves adaptable to it.

It is apparent therefore that fruit, once a luxury in the temperate zones and a largely unrealised asset in warmer lands, has become a product of world-wide importance. Vast areas are devoted solely to fruit cultivation, enormous business interests are concerned with the marketing of it, and an ever increasing degree of experimentation is being carried out to improve its quality, increase its quantity, and combat the innumerable pests and diseases which inevitably appear when one crop is grown alone over large areas.

Fruit is now a potential asset wherever it can be easily grown, but the man today who cultivates it is not in the position of his father or grandfather, who if he could sell a small quantity of any kind in the limited market, realised a big profit on it. Fruit today must conform to the very rigid standards that the markets demand, and only large scale production and cultivation on the soundest economic basis can enable it to be sold at a profit in competition with other growers. Fruit in fact, like many other agricultural products to-day, has become less a small farmer's crop and more suited to capitalist agriculture on a plantation scale, although it is of course possible and profitable for the small holder to work in co-operation with the capitalist.

In this Colony fruit is grown only by the small farmer, to supply his own needs and those of a somewhat limited local market. A small outlet has been found for plantains in the Islands, but otherwise not only is there at present no fruit exported from the Colony, but occasional importations of citrus occur when the local trees are not bearing. Is it possible for the local farmer by co-operative effort, despite rather unfavourable conditions, to gain a footing in any of the world's fruit markets?

The vexed question of a local banana export trade is still '*sub judice*', and we will not enlarge upon it here. In this connection, however, it is perhaps not

always realised that the production of bananas and their profitable sale on a foreign market are two problems which must *both* be solved before bananas can be of any material value to the Colony as an export crop.

In regard to citrus, it is very evident to all who have sampled it that good fruit can be grown locally, and there is no reason to suppose that grapefruit conforming to the market's requirements could not be shipped and sold abroad. Fruit of the necessary standard has in fact already been produced on the Department's Experimental Orchard in the North West District. Furthermore, the Department of recent years has encouraged the cultivation of this crop, distributed plants of the varieties asked for on northern markets, and assisted the keener farmers to establish their own nurseries. The output of fruit should increase materially in the next few years. It has to be remembered however, that the Colony is far from the world's biggest fruit markets, that the output of grapefruit from countries more suited to its cultivation is increasing annually, and that the margin of profit in the sale of this product is therefore becoming smaller, so that no one can expect to make 'easy money' out of it.

Limes too grow here abundantly, but the chemist has stepped in, and nowadays synthetic Lime Oil can be produced more cheaply than the natural product. The possibility of finding a market for green limes is however at present being investigated.

To turn to some of the other fruits, for which a market is beginning to appear in the North, the most promising local product is the mango. Although very good individual pear trees are grown in the Colony, the locally grown Avocado as a whole does not compare favourably with those produced elsewhere, and it is in any case a most difficult fruit to transport. The mango, however, offers certain possibilities. Owing chiefly to the uncertainty of the seasons as regards rainfall, the mango crops vary considerably, but good yields are obtained on an average about once in two years. To secure a footing in this market, it is essential that only fruit of the best quality be sent, most carefully packed. The mango is still but little known in Canada, and is regarded as a luxury, successful shipments fetching good prices. Much depends on the first impression created on purchasers, and already one small shipment of very poor quality fruit, sent by irresponsible persons, has created a bad impression, which the Department has endeavoured to overcome by shipping better quality fruit that had been properly packed. It will be possible also in the near future to increase the output of grafted mango plants, since the trees planted by the Department for this purpose, are now maturing.

It is apparent therefore that the Colony, though by no means ideally suited to compete in the world's fruit trade, should be able to find outlets for a certain amount of fruit, and though fortunes are not likely to be made, the intelligent farmer, if he will pull together with his neighbour, should be able to make his fruit trees, once established, a very definite asset to his farm and hence to the Colony's resources.

HINTS ON VEGETABLE CULTURE.

(Compiled by the Department of Agriculture).

FOREWORD.

A small area on a sand reef at Plantation Cecilia, East Coast, Demerara, was converted by the Department of Agriculture in 1927 into a sub-station for the study of truck garden and related crops. The soil is typical of the sand reefs of the Colony and provides a good experimental area for trials and demonstrations with these crops. This sub-station has fully justified its existence, at the same time providing a basis for extension of similar work and seed centres at Whim, Berbice and Henrietta, Essequibo. Much of the improvements and extension in recent years of vegetable cultivations, School and Home Gardens in the districts and throughout the Colony, is due to the activities of these sub-stations. The information herein given has been accumulated mainly from the trials conducted by the Department since this work was inaugurated.

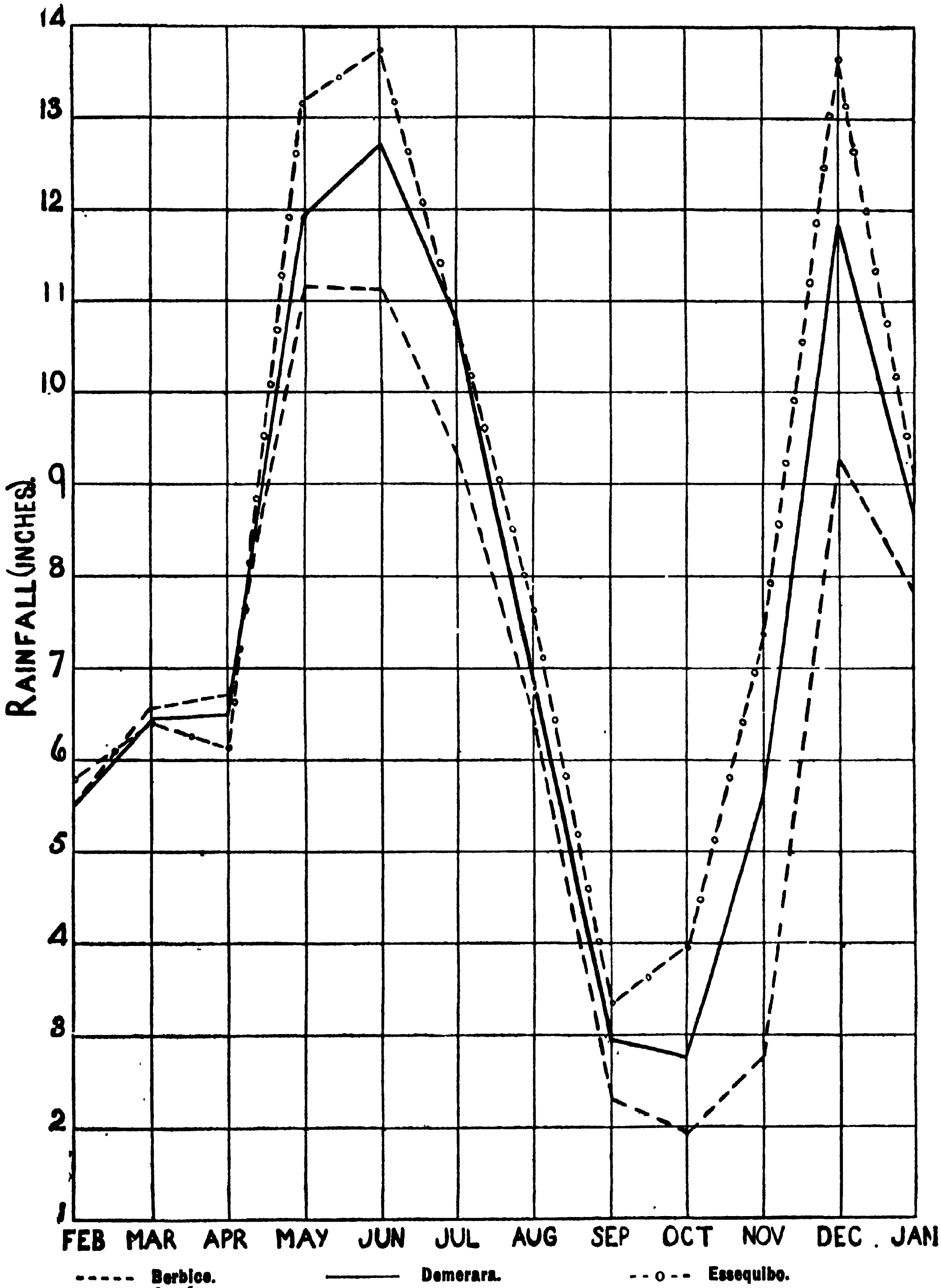
GENERAL.

Essential requirements in vegetable cultivation are rich, friable soil, accessible supply of fresh water, good drainage and constant attention. Where cultivations depend mainly on rainfall, activities are largely seasonal and restricted to the less exacting types of vegetables. Given suitable conditions, success will be in proportion to the manner in which the young plants are treated during the first four weeks after transplanting. When not occupied with a vegetable crop, beds should not be left uncultivated for long periods. That is, if a crop is reaped and the bed is to be vacant for any period from four weeks on, it should be sown with a quick-growing legume. This will keep down weed growth and enrich the soil. Black eye peas or cow peas are recommended. All vegetable lands should be sown to a cover crop at least once every two years, preferably with the mid-year rains. Where exposed to strong winds, windbreaks should be provided. Useful temporary ones are pigeon pea, sugar cane and guinea corn which are also food crops. *Gliricida maculata*, a quick-growing leguminous tree, which can be pruned, makes a satisfactory permanent windbreak while a number of common hedge plants serve the purpose equally well.

SEASONS.

From Plate XXIX it can be seen that in this Colony there are, generally speaking, two dry and two rainy seasons in the year. The rains begin towards

Rainfall on Coastlands, British Guiana.



There are two rainy and two dry seasons in the year. The rainfall distribution has a most important influence on the cultural operations with vegetable cultivation.

the end of April and are heavy until July, are less in August, while September to November are relatively dry. Towards the end of November rains begin again and continue to January. February to the middle of April are drier but not as dry as from September to November.

In addition to rainfall requirements, most vegetable crops show distinct seasonal preferences and this should not be lost sight of when planting. The best time to sow is in late October or early November and to plant out in the field in November, especially in the case of onions, cabbages, tomatoes, cauliflowers, Kohl Rabi. These crops, when grown during the hot dry months of the year, are likely to give disappointing results and are usually at their best when reaped between February and early May. For some of the more hardy crops, a second planting can be made with the April showers and cultivations continued as weather permits.

SEED BOXES AND SEED BEDS.

Seed boxes are essential for starting the seeds of most vegetables and careful preparation is necessary. A certain amount of light shade and protection from wind and heavy rains are essential. The boxes should not be too large or too heavy as they often require to be shifted either in the nursery or at transplanting time ; 2 ft. by 1 ft. by 6 in. deep is a convenient size. A number of holes about ½ inch in diameter should be bored in the bottom of the box to facilitate drainage. Good soil of average fertility, but not too rich, should be used, after being sifted, to remove stones, lumps, etc. As a precaution, the soil may be sterilised by placing on a galvanised sheet and heated over a fire. First, place a layer of the coarse stones at the bottom of the box. Over the stones place a layer of semi-decayed material such as dried plantain leaves, grass or coconut fibre ; next a layer of smaller stones or gravel, and finally sufficient sifted, sterilized soil to come within a short distance of the top of the box. The surface of the soil should be levelled with a piece of board with a straight edge. The box is then ready for the sowing of seed.

It is often advisable to afford further protection from ants, etc., after sowing by placing the boxes on a wooden stand, the legs of which have been treated with tar, ant tape, tangle-foot or other repellant which should be periodically renewed.

Seed beds should be carefully prepared. The beds should be protected from strong winds. Stakes should be in position and arranged so that coconut branches, etc., may be used for protection against heavy rains and the hot mid-day sun. Excessive shade produces weak, spindly plants and so, in many cases, it is found advisable to remove all shade in the mornings and afternoons.

The soil should be well drained, so broken up that it is reduced to a fine tilth, loose and quite free from big particles of any kind. If the soil is too

heavy; it can be improved by adding lighter soil or leaf mould. Ants are very destructive to the seed bed and it is advisable to search the surroundings for nests which should be destroyed. In addition, straw, or similarly easily ignited material, should be placed on the seed bed and lighted in order to "sterilize" the soil from insects and any harmful organisms.

The beds should be raised about 18 inches and should not be more than 5 feet in width to facilitate watering, weeding, etc. The seed bed should be made firm by pressing down, say, with a board, and thoroughly soaked before the seeds are sown.

In the seed bed, the seed should always be sown in drills or lines and never broadcast as the seedlings can later be thinned out easily and transplanted with the minimum amount of damage.

Manure and Compost.

The vegetable gardener must make provision for the conservation of vegetable matter and the subsequent breaking down of this material into manure. Unless with the object of destroying insect pests, diseases or weeds, waste material collected from the garden should not be burnt but should best be collected and heaped up or placed in a suitable pit until decomposed sufficiently for re-application to the vegetable beds.

Farmyard manure is essential to vegetable cultivation and if the farmer possesses no animals of his own, he should make arrangements for the collection of this valuable source of plant food. A layer of vegetable refuse and manure about one foot deep is formed first, and then on this is sprinkled a covering of soil and a little lime. Another layer of refuse may then be added. If the whole is covered with a thick layer of soil it will remain quite clean, and will not breed flies. The 'compost' needs four to five months to mature, during which period it must be kept moist by watering if there is no rain.

As manure loses much of its soluble plant food if exposed to heavy rains, and as drying winds also cause loss, some covering should be provided. Compost when wanted for use on the beds should be obtained by cutting the side of the heap vertically and removing the quantity required. In order to have a continuous supply of well rotted manure a second compost heap should be started before the first has been demolished.

The advantages of activated compost heaps are being more and more generally appreciated and the practice is being freely adopted in those areas where abundant supplies of vegetable matter are available. Those interested should consult their District Officers or write to Headquarters, Department of Agriculture, for detailed instructions in regard to this method of waste matter utilization.

For small gardens adjoining house lots in the village or town, a pit instead of a heap is recommended as a pit is less unsightly.

Liquid manure has frequently been found to give young seedlings a good start and vegetable growers who desire to force on growth will find it helpful. Liquid manure may be prepared as follows:

Sulphate of Ammonia	—	8½ lb.
„ „ Potash	—	4½ lb.
Superphosphate of Lime	—	10½ lb.

Dissolve three ounces of this mixture in four gallons of water which quantity should then be distributed over an area of about 25 sq. ft. As an alternative, suspend a bag of animal droppings in a drum of water until the water becomes the colour of strong tea. Apply at the same rate, *i.e.*, 4 gallons to about 25 sq. ft. The soil should always be wet before liquid manure is applied.

MULCHES.

One of the principal objects of mulching is to conserve moisture and hence the original and generally advocated type of mulching is that known as a "dust" mulch. With a soil mulch the intention is to lessen evaporation from the surface by frequently cultivating the surface soil. Artificial mulches are formed by covering the surface of the soil with straw, leaves, cut grass, paper or any similar material. An artificial mulch such as that formed of straw, leaves, etc. acts also as a manure and is of considerable benefit to the crops. Apart from helping to conserve moisture in the soil, humus is added. Cracks in the beds, caking and washing of the surface soil are minimised and weeds are kept under control. If available, the mulch should be applied several inches deep and even cover crops, when it is not intended to dig them in, may be cut and used as a mulch; it should be mentioned, however, that in general it is preferable to bury green dressings.

CULTURAL METHODS.

The culture of the principal vegetables is dealt with in some detail in the following pages. The vegetables are grouped according to their botanical relationships and the families appear in alphabetical order.

CHENOPODIACEAE.

BEET ROOT.

Beet grows best in a light or sandy soil. The seeds should be sown thinly in drills about half an inch deep, 9 inches apart in beds of thoroughly prepared soil; when the plants have three or four leaves, thin out, later thin to 6 inches

apart in a row. Fresh manure should not be applied immediately before sowing since this frequently causes forked roots. Manure should be applied some months before the seeds are set. The seeds frequently have to be sown in boxes or seed beds on account of damage done by ants in the field, but transplanting should, if possible, be avoided. If transplanting is to be done, care should be taken not to break the root which should not be doubled or bent in the new holes. Beet matures in about three months. The variety recommended is Sutton's *Globe*, the seed of which can be obtained from most seed suppliers.

COMPOSITAE.

JERUSALEM ARTICHOKE.

The Jerusalem-Artichoke is a very good yielder. The plant does best in a rich, light soil which enables the roots to develop. The bulbs can be set in a nursery bed and the plants when about 4 to 6 inches in height may be spaced in beds, which have been given a liberal quantity of manure at about 2½ ft. by 3 ft. If preferred, the bulbs may be planted to their permanent position.

LETTUCE.

Experiments with a number of varieties have demonstrated that, of the cabbage type, the *Golden Ball* from Sutton's (England) and the *Migronette* from Henderson's (U.S.A.) are the best under local conditions. The former is a crisp and delicious lettuce ; there is little wastage and practically every leaf can be utilised. Both varieties are highly recommended. The loose leaf types (*i.e.* non-heading) are less exacting in their requirements and develop rapidly in rainy weather. Among the better known varieties are *Grand Rapids* and *Black Seeded Simpson* from Henderson's. The *Romaine* or *Cos* types are not at their best under tropical conditions and are not specially recommended. Generally speaking, seed from locally grown plants will not give as good results as imported seeds.

Seed should be sown thinly in boxes and shaded. Care must be taken with watering ; many complaints have been received about seeds failing to germinate, but in many cases the responsible cause is neglect in the preparation of the soil in the seed boxes or seed beds. Frequently too, beds are left uncovered and the small seeds are killed by the sun or removed by ants.

Seedlings should be planted out during the fourth week, when they are strong enough. Beds should be 4 ft. wide and length according to requirements, with 1½ ft. wide drains between the beds. Apply a liberal quantity of rotted cow manure and work it in to a depth of five inches. If the soil is very dry, it should be watered before planting and immediately after ; the plants should not be allowed to suffer for the lack of water. Space seedlings 8 inches each way. If the weather is hot, shade for three days.

Unsuitable varieties, neglect of ordinary care and attention are responsible for poor quality in lettuce—a vegetable so easy to grow. On no account should the plants be allowed to become overgrown, or a bitter flavour and coarse texture will result. Good lettuce is seldom offered for sale locally; it is frequently too old or grown under too strong exposure to the sun. Lettuce thrives best in the rainy season, provided the plot is well drained. In the hot weather the plant should be watered twice daily and the beds kept free of weeds. To obtain a constant supply of crisp, succulent lettuce, seed should be sown fortnightly.

CRUCIFERAE.

CABBAGE.

Much difficulty has been experienced in finding a variety of cabbage which heads freely under local conditions. After long and careful trials, it has been found that the *Succession* variety from Henderson's and *Foremost* from Suttons give the best results. Season exerts an important influence on heading, the greatest success being achieved during the early and cooler months of the year. The best season for sowing is with the end-of-year rains.

Seeds should be sown in carefully prepared seed beds or boxes one inch apart each way, so as to get strong and sturdy seedlings; if this is done, there would be little need for thinning out. The soil should be loose and rich, so as to give the plants a good start. Seedlings should be planted out during the fourth and fifth weeks after sowing and spaced 18 inches each way in diamond form. The plants are liable to be attacked by bud worms during the young stage; they should be searched daily and the worms destroyed. If the bud is destroyed the plant will not head; hence the injured plants should always be taken out and new ones supplied.

When the seedlings are established, they should, every ten days, be given an application of liquid manure which can be prepared as explained above. As the plants develop, care must be taken whilst watering that this does not get into the folds of the leaves as this provides a suitable condition for the start of fungus and other rots. If these directions are carried out, the plants should make rapid growth and head satisfactorily.

CAULIFLOWER.

Sow seeds in boxes or beds and when the seedlings are strong enough, that is, about the fifth week, plant them out in beds worked up with plenty of well-rotted cow manure 2 ft. by 1½ ft. To grow good cauliflower, it is necessary to rush plants on quickly, and never allow them to be checked at any stage of their growth.

Dressings of bone meal every ten days at the rate of one ounce to four square feet during the growing period will materially increase the crop. The plants

thrive best when sheltered and should begin to flower three months from the time of sowing the seed. The heads should be reaped when firm and white, those of medium size being more luscious and more delicate in flavour than those which have been allowed to become too large and of brownish tint.

The following varieties are recommended from Sutton's India House: *Maincrop Benares, Early Benares, Maincrop Patna, Early Patna.* The English varieties do not do well under local conditions.

KOHL-RABI.

This is a vegetable intermediate between the cabbage and turnip and combines the flavour of both. It is of a delicious flavour and is best used when half grown as it is then tender. If left to become large it acquires a fibrous consistency. Sow seed in beds or boxes and when large enough, usually in five weeks, the seedlings should be transplanted into well manured beds, placing the plants nine inches each way. The variety recommended is Sutton's *Early White.*

CUCURBITACEAE.

CUCUMBERS.

The soil should be liberally manured as the plants are gross feeders. Seeds can be sown in boxes and transplanted before they begin to run, but it is better to sow seeds in their permanent position, putting three seeds in a hole, holes being 5 feet apart each way. Cucumbers and all vine seeds should be planted with the point downwards.

If more than two seeds germinate, destroy the weakest plant. If the plants are inclined to grow without branching freely, pinch off the ends of the shoots; this will cause the plant to branch and more fruit would be obtained. The plants react unfavourably to very dry conditions, therefore, the plot should be mulched to conserve moisture and to prevent the fruits being stained or scorched. Care should be taken to see that the fruit is picked when young, that is, before the seeds become hard.

There is a large number of varieties from which to select, *e.g.*, Sutton's *Improved Telegraph*, *Prolific* and *Short Prickly* or *Gherkin.*

The cultivation of Squash and Pumpkins follows the same general lines. Of the long and round local types of Squash tried, the former has given the best results.

LEGUMINOSAE.

Beans.

During the four years, 1932 to 1935 inclusive, a large number of varieties of beans have been under trial. Of the Lima beans the following have been very successful : *Lima No. 3* from Nigeria and Henderson's *Bush Lima.* They are of the dwarf type, are good bearers and can be grown without much trouble.

A plot measuring 198 sq. ft. was planted with *Lima No. 3* on November 22, 1934, to ascertain the yield of dry seeds per acre. The seeds were planted 1½ft. between the rows and 1 ft. in the row. On December 20, the first flowers appeared and on January 30 the first lot of dry pods was collected. The cropping period extended to May 16, 1935. The yield was 9½ lb. or 2,090 lb. per acre. A similar plot of Henderson's *Bush Lima* was planted on the same date. The cropping period extended from January 28 to May 16. The yield was 8 lb. or 1,760 lb. per acre. The pods, if picked when green, would prolong the life of the plant and a greater yield would be obtained. They are shelled for use, either green or dry. Good reports have been received from persons who have planted these beans.

There are several varieties of salad beans but the most successful under local conditions are *Kentucky Wonder*, *Yard Bean*, *Waby Bean* and the finger-shaped *Bonavist* (Séme). They should be planted in friable soil at a distance of 3 feet between the rows and 2 feet in the rows. A little well-mixed manure should be worked into the holes before sowing seeds. The plants should be earthed up and staked when 6 inches high.

Climbing beans are of most value to those with small garden space. They can be grown for covering the garden fence or on stakes or wire netting. They have a very long cropping season and give a much larger yield per plant than most of the dwarf varieties. They may be allowed to run on the ground, but if grown on fence or stakes the larger crops wlll repay the trouble.

Salad beans should be picked young, and, to obtain a constant supply, it is best to plant a number of varieties throughout the year, choosing showery weather. It should be clearly understood that most varieties of beans will show their best characteristics only when grown under favourable conditions of soil and season.

The seeds from a cross between *Lima Beans* and the local *Sinebone* were planted out and kept under observation for six generations. Good results have been obtained from this cross. Plants grow to a height of 2 feet, and are inclined to trail if encouraged by stakes conveniently placed. The mature pod is flat, long and fleshy, with white seeds. The full grown pod is 4½ inches long and inch wide. The green pods make a good vegetable similar to *Sinebone.*

A rich loam gives good results, and if a clay soil is well drained and cultivated, good yields would also be obtained. Plant seeds 1½ ft. between the rows and 1 ft. in the row. Work in a small quantity of manure to each hole before planting. The plants begin to flower in the fourth week and edible pods are obtained in the sixth week. Frequent picking should be done to prolong cropping period.

This new bean is superior in cooking qualities to *Sinebone* when used dry and not as a salad, because, being white seeded, it has a better appearance than the *Sinebone*.

PEAS.

Black eye peas and the edible cowpea are so similar that they can be dealt with together. They are both of approximately 12 weeks' duration and should be planted so as to give a good cover 1 ft. apart in the row with 2 ft. between the rows and at the rate of 3 seeds to the hole. They are very useful as a catch crop to plant between new cultivations of bananas, etc. They are inclined to deteriorate after successive plantings so that all seed for future sowings should be selected. Both of these make excellent salad beans if used at the right stage.

Pigeon peas are a very favoured article of diet either green or dry and are not as extensively grown as they could be. On a large area they are a useful money crop. They can be cut back after bearing; in this way two or more crops can be obtained. They should be sown from 7 ft. x 7 ft. to 10 ft. x 10 ft.; 9 ft. x 7 ft. is a favourite distance; four seeds to the hole and the plants later thinned out. When established, the duration differs according to variety. A few plants as a hedge around a vegetable garden act as a windbreak besides providing a welcome adjunct to the table.

LILIACEAE.

ONIONS.

Soil and Preparation.—The soil should be friable. Rich, sandy soils give excellent results. Heavy, wet soils must be avoided, but most soils will grow onions if properly drained and well cultivated. Good rotted stable manure or compost should be forked into the land a month or two previous to planting; if the soil is made very rich, the onions are apt to be "watery" and their keeping qualities are affected. If the soil is heavy and retains moisture excessively, the bulbs and leaves do not tend to dry out thoroughly enough.

The instructions given in regard to preparation of seed beds must be carefully followed and the beds should be in fit condition so that the seed can be sown immediately after distribution is made by the Department of Agriculture in November. Ants are very destructive to the seed and it is advisable to destroy any nests found in the vicinity of the planting area.

The seed should be sown in drills ½ in. deep and 6 in. apart. When about 5 in. to 6 in. high the seedlings should be thinned out to about 6 in. apart in rows, the surplus seedlings being then used for planting other beds. If a fair area is to be planted, sow the seeds at different intervals so that the crop will not ripen all at the same time. Good seed will start to grow in 5 or 6 days, but it sometimes takes 3 or 4 days more. At the time of transplanting the roots should be trimmed and the seedlings kept moist by wrapping them in a wet bag until planting out in the field. Young seedlings should not be carried about in one's hands, and should be inserted at the same depth as when in the seed bed, the soil being pressed at the base and not around the collar of the plant. Deep planting is to be avoided.

Cultivation.—Keep free from weeds, and try to maintain a soil mulch in order to conserve moisture. Cultivation can be shallow as the onion is a surface feeder. Never mould up the plants. The question of watering is important. Careless watering will kill many of the young seedlings. If the weather is dry, one thorough watering every day or every other day is generally sufficient.

Harvesting.—Onions should be ready for reaping about four months after sowing. When quite ripe, the leaves turn yellow and shrivel, dry at the neck and fall over. In some countries towards the end of the growing period, the tops are bent over to hasten maturity and form well shaped bulbs. Under normal conditions this is not necessary. The bulbs should be lifted carefully, preferably on a dry day, freed of earth, and if the weather permits, left with their roots upturned for a few hours and then removed to a cool, airy room. During wet or showery weather, they should be taken indoors at once. They must never be heaped up in the field, nor should they be allowed to remain in the open for any length of time—too long exposure in a hot sun will injure the bulbs.

Curing.—For successful curing, onions require to be dried in a cool well-ventilated room, on shelves constructed so as to secure a free circulation of air around the bulbs—mesh wire on frames is very suitable for this purpose. The onions should be placed in single layers on the shelves and never one on the other. Usually it takes 5 to 7 days before they are quite cured —at this stage they should have a well marked dry outer skin. For local market the onions may be plaited in strings before the tops have entirely dried out, the curing being completed on the string.

Yield.—The yield varies with the season, the kind of seed, the distance apart of the rows, and the cultivation afforded. Anything from 2 tons to considerably over 10 tons per acre may be obtained. The two varieties recommended are the Red and White of the Bermuda type, seed of which is obtained by the Department from Teneriffe. Other types are not usually successful.

ESCHALLOTS.

For successful cultivation, the soil should be well tilled and manured, and the bulbs planted in raised beds, which have been consolidated. The bulbs must

be dried, tops and roots cut off and planted 4 in. apart. In selecting the bulbs it is better to choose those of average size which should be inserted in the soil at about their own depth. Pay attention to watering and shading in the early stages. Red and white varieties are obtainable.

SOLANACEAE.

TOMATOES.

The cultivation of this crop has previously been dealt with (*Agr. Jour., of B.G.*, Vol. V. No. 2 : pp. 124-127) and only the salient points are recapitulated here.

Varieties: Among the varieties tested are *Crimson Cushion*, *Ponderosa*, *Golden Ponderosa*, *June Pink*, *Brimmer* and *Marglobe* from Henderson's; *Beauty*, *Princess of Wales*, *Best of All*, *Golden Queen*, *Early Market*, *Maincrop* and *Tenderloin* from Sutton's and *Bonny Best* and *John Baer* from Ewing's, Canada. Experiments carried out up to 1931 showed that the best of the large or luxury type is the *Crimson Cushion*; as the demand for this type is limited, attention was thereafter concentrated on the more medium sized varieties.

Sutton's *Early Market* is the best all-round tomato yet tried and is recommended with confidence; under local conditions it not only gives the heaviest yield but is the most resistant to Mosaic and Blossom-end Rot. *Marglobe*, while not giving so good a yield as *Early Market*, is, however, a more desirable size for purely salad purposes. For those wishing an exceptionally large tomato, *Crimson Cushion* (of the *Ponderosa* type) is recommended.

The experiments carried out tend to show that imported seed gives better returns than seed collected from fruit grown locally. The advice of the District Agricultural Officers should be asked as to the varieties likely to give best results.

Cultivation.—The seed should be sown thinly in a seed bed, or box if preferred. The seedlings should be transplanted at about four or five weeks old in well prepared beds, free from weeds. The beds should be 4 feet wide, the seedlings spaced 2 feet apart in the rows and 3 feet between the rows and staked when 18 inches high.

As soon as the young plants begin to branch, all the young shoots should be picked off except the strongest, at the base of the plant, which should be allowed to remain to form a second stem. It is important to remember that it is not advisable to grow more than two stems; this operation controls both the quality of the fruit and the yield in weight.

If the weather is dry it will be profitable to mulch the beds with dry rice straw or similar available material.

A careful watch should be kept for mosaic disease. This is easily detected by a mottling and curling of the leaves; all plants attacked by this disease should be destroyed, as mosaic is very virulent and is transmitted from one plant to another by the mere process of handling. Caterpillars must also be looked for, picked off and destroyed.

When the fruit begins to develop, any fruit observed with a black scar should be picked off; this is known as "Blossom-end Rot". The fruits are not saleable if allowed to develop and it is wiser to pick them off at an early stage. The period taken for the crop to mature is 84 days, with the exception of the *Marglobe* and *Golden Queen* varieties which ripen in 75-80 days.

The local demand for tomatoes has not yet been met nor fully developed, and tomato-growing is worthy of more attention from farmers and gardeners—especially those suitably situated in regard to cultural requirements and within easy reach of Georgetown.

Egg Plant or Boulanger.

This plant requires a similar type of soil to that recommended for tomatoes—sand reefs and adjoining loams. If a heavier soil is being used, it should be thoroughly forked, and 'long' manure well mixed with the soil some time in advance. The seeds should be sown in a seed bed, or, preferably, in a seed box. The seedlings should be transplanted to the field in holes 3 ft. by 4 ft. prepared in the same way as for tomatoes. Water the seedlings and weed when required. When the plants are high enough the soil around each plant should be loosened. If large fruit is desired, only a small number should be allowed to mature on each plant. The crop matures in 4 to 5 months. The variety which has given the best results is *Black Beauty* from Henderson's, a large round fruit. The local elongated fruit varieties are also good yielders and are popular on the local market, especially the pink skinned type.

UMBELLIFERAE

Carrots.

Carrots do best in a sandy loam which has been forked deeply to allow the long tap roots to grow straight. No seed boxes are necessary. Drills 1 ft. apart and ½ in. deep should be made and the seed sown continuously in the drills. A close spacing of seedlings ensures that the roots go downwards which otherwise are inclined to become forked and unsightly.

The seedlings when still young should be thinned to about 4-6 inches apart and as soon as the roots have begun to take shape, kept free from weeds by hand forking. Application of liquid manure will encourage quick growth. Carrots

used when half-grown are more delicate in flavour than when mature. The varieties recommended are *Early Gem* from Sutton's and *Intermediate* from Henderson's.

SPINACH PLANTS.

Indian Kale.—This is a dwarf plant with tannia-shaped leaves which sends up new stems freely. It is propagated by dividing the clumps and planting them 1 ft. between the rows and 9 inches in the row. The plant does well on clay soil and responds to heavy manuring and watering. It grows exceedingly well in damp situations. The leaves are used as spinach.

French Calalu.—This plant grows either from cuttings or from seeds and runs as a succulent, herbaceous vine. It bears a dark purple, juicy berry which contains a single seed. The plant trails if allowed to do so. It is better to grow this plant from seeds and when the seedlings are strong enough, plant them out in well prepared beds 12 inches apart each way. They should be kept short by cutting regularly. By this method of cultivation a larger yield would be obtained and no arbour is required. The leaves, which are very numerous along the vine, are heart-shaped and fleshy and are used as spinach.

Caterpillar Calalu.—This is a very hardy plant and is easily grown, thriving best on sandy soil. The plant which is grown from seed, attains a height of 2 to 3 feet and bears large clusters of flowers at the top of each branch. It is very palatable either in soup or as a dish of greens. To get the best out of this plant, it should be cut when young, that is, before it flowers.

Swiss Chard.—This plant has succulent, crimpled green leaves, with a thick, whitish leaf stalk. It is a quick grower and often reaches a height of 2 feet. The plant requires a rich, friable soil with plenty of manure. The seedlings should be spaced 20 inches between the rows and 14 inches in the row ; if this is done, a plot measuring 150 sq. ft. would give a dish of green every alternate day. *Chard* possesses an excellent flavour and no garden should be without this useful vegetable, seed of which can be obtained from almost any seed supplier.

INSECT PESTS.

However desirable to avoid technicalities and scientific terms in a paper of this sort, there is no escape from the need to know something about insects, their life, their habits, and even small as they are, their structure ; for such considerations are at the bottom of all insect control measures, and the intelligent application of preventive and remedial measures is only possible in the light of such knowledge. It is, in fact, no exaggeration to say that a campaign may miss the mark entirely on account of ignorance of a few biological facts and so result in waste of time and money besides unnecessary loss of crop.

For this reason it will be well to stress a few elementary principles of entomology. Firstly, all insects start from eggs which in the case of butterflies and moths are usually laid in clusters on the underside of leaves where they form conspicuous masses (see Fig. 1) which can readily be collected or destroyed if one is on the look out for them.

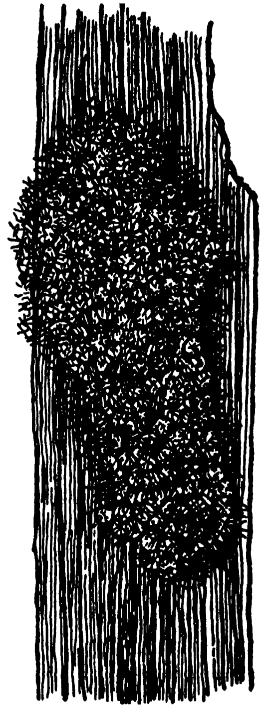


Fig. 1—An egg mass of a leaf-eating caterpillar. (Re-drawn after Walton and Lugnibill).

The next stage in the insect life cycle is the 'worm' or larva or nymph. (See Fig. 2). It is not necessary to go into the entomological distinction between these two forms, the main point to grasp is that in most cases control is easiest in this stage since the insects are not only very delicate but often also gregarious. The final stage is the adult (see Fig. 3) which is often conspicuous and the presence of which often indicates the onset of an attack. Fig. 4 gives a good idea of the different stages some insects go through in the course of their development.

Another principle to be borne in mind is the diverse methods of feeding. The pests we are at present concerned with can be divided broadly into biting and sucking insects. In the case of the former, stomach poisons can be used with success whilst, in the latter, contact insecticides have to be employed. Other insects like ants live in colonies and go out in foraging parties. In these cases the nests must be found and destroyed.

In many cases, even more useful than chemical poisons, are cultural methods of insect control. A good many insects go through part or whole of their life cycle in the soil, others have a resting stage (see Fig. 5) lasting as long as two

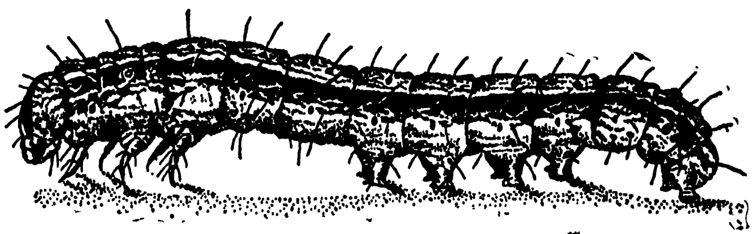


Fig. 2.—A typical "worm" or leaf-eating caterpillar. (Re-drawn after Walton and Lugnibill).

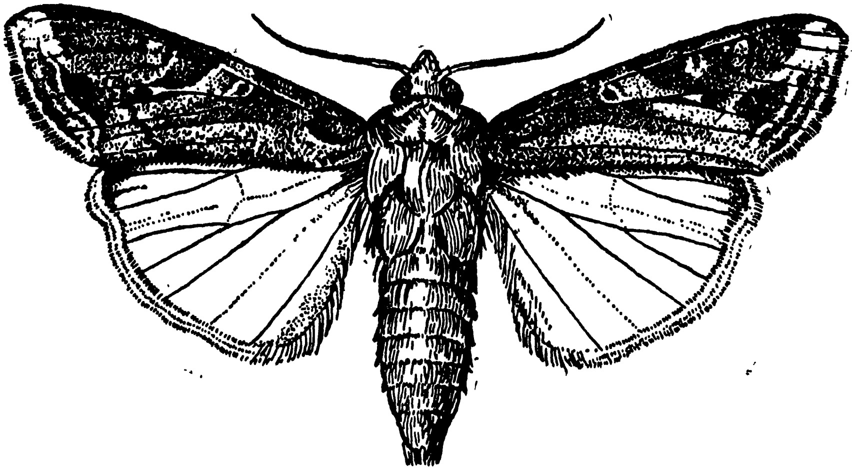


Fig. 3.—The adult or moth which emerges from the pupa or resting stage. (Redrawn after Walton and Lugnibill).

weeks in the remains of harvested truck crops. In such cases the inestimable value of ploughing or forking in the stubble and harrowing the soil is obvious.

Then again the presence of weeds in and about the cultivation is apt to encourage a wealth of larger bugs (see Fig. 6) which quite readily turn their attention to cultivated plants of the same or similar orders. Furthermore, rank and especially overgrown trees and bad drainage are all responsible at times for the presence of certain pests.

Crop rotation and mixed cultivation are two useful practices as they prevent the accumulation of pests. Do not plant the same vegetables or crops successively in the same beds if it can be avoided.

So much for general principles; now to come down to specific remedies, the following insecticides will be found effective:—

(1) For leaf-eating caterpillars such as the tomato caterpillars, *Protoparce* and *Phytometra*, cabbage worms such as *Pieris*, spinach worms such as *Psara* and *Amyna*, and in fact any other nibbling insects.

Lead arsenate	...	1 oz.
Water ...	...	3 gls.

First make a paste then stir in the rest of the water and spray on to the foliage that is being attacked.

(2) For sucking insects such as plant-lice and white-flies on cabbage and cucumbers, Lacewing bugs on egg plants, thrips on beans and other soft bodied sucking insects (see Fig. 7).

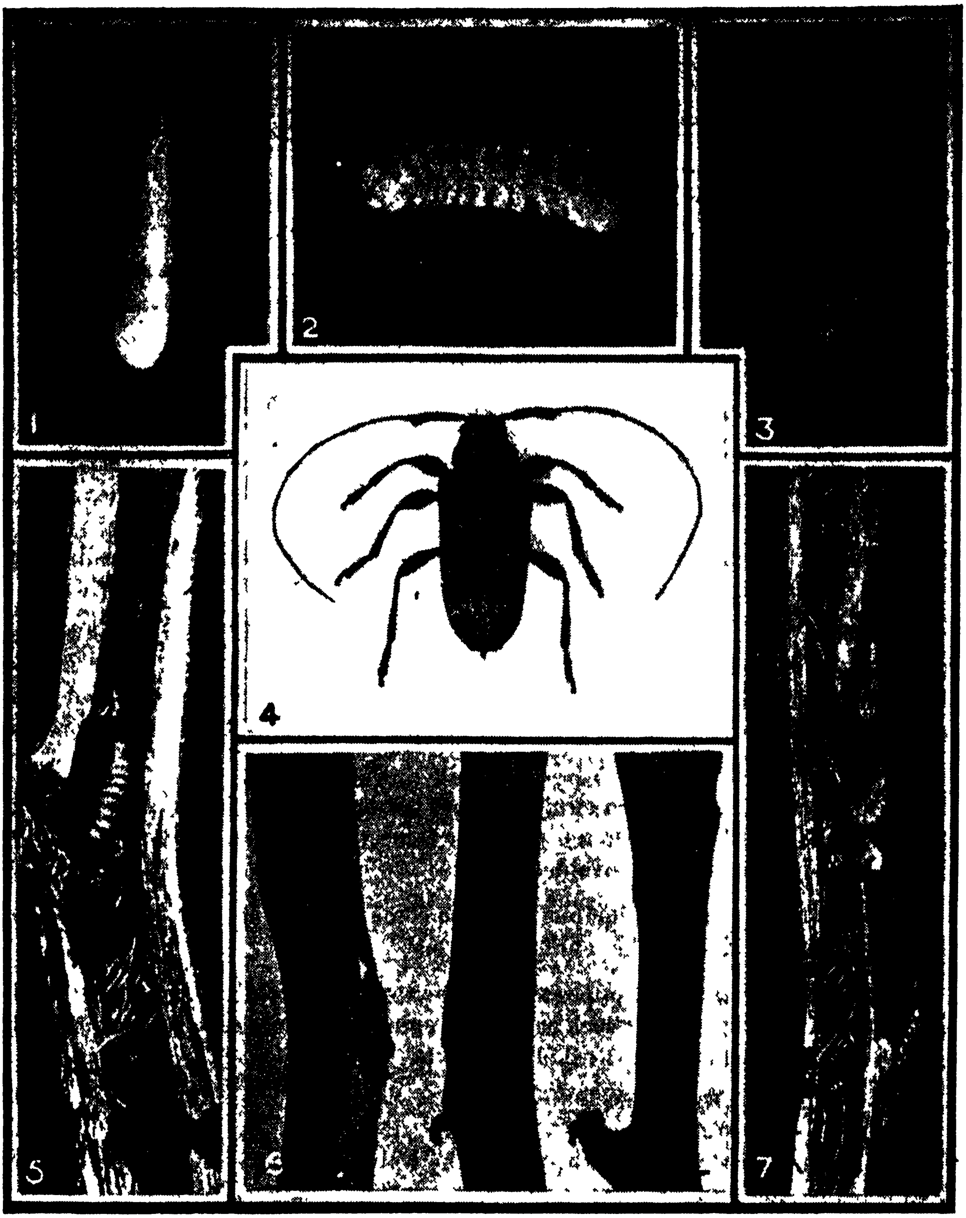


Photo by *L. D. Cleare, Jnr.*

FIG. 4. Stages in the development of the Egg-plant Stem-borer, *Alcidion Deletum* Bates.

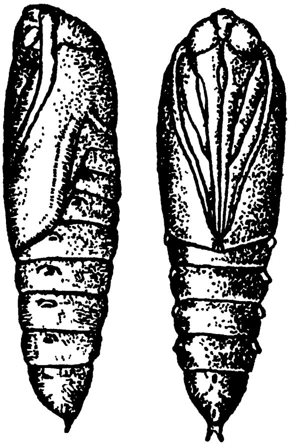


Fig. 5.—The pupa or resting stage. (Re-drawn after Walton and Lugnibill).

Nicotine sulphate	...	5 drops
Water ...	...	1 beer bottle

to be sprayed on the under surface of the leaf so as to make contact with the pest. In some cases where a waxy coating is present on the insect it is advisable to add a crumb of soap and a tablespoonful of molasses—the former to dissolve the protective coating and the latter to act as a sticker.

(3) For crickets and mole crickets attacking seedlings generally.

Paris Green	...	1 oz.
Bran ...	...	2 lb.

Molasses sufficient to make sticky mass. Scatter a small quantity on several successive nights on the seedling beds.

(4) For ants such as *Solenopsis*—the red stinging ant—on egg plants, ochro and other vegetables, the following measures are recommended ; a search should be made for the nests which are usually to be found in the immediate neighbourhood. The destruction of the colonies is easily accomplished by flooding them out with engine or gas oil. An alternative method is to pour a tablespoonful of carbon bisulphide into a narrow shaft sunk about six inches into the nest which should then be covered over with damp bags. This substance is highly inflammable and should be handled with great care.

There are a good many useful insects which it is well to know. These include marabuntas and a variety of lady birds which feed on caterpillars and plant-lice respectively. (See Fig. 8).

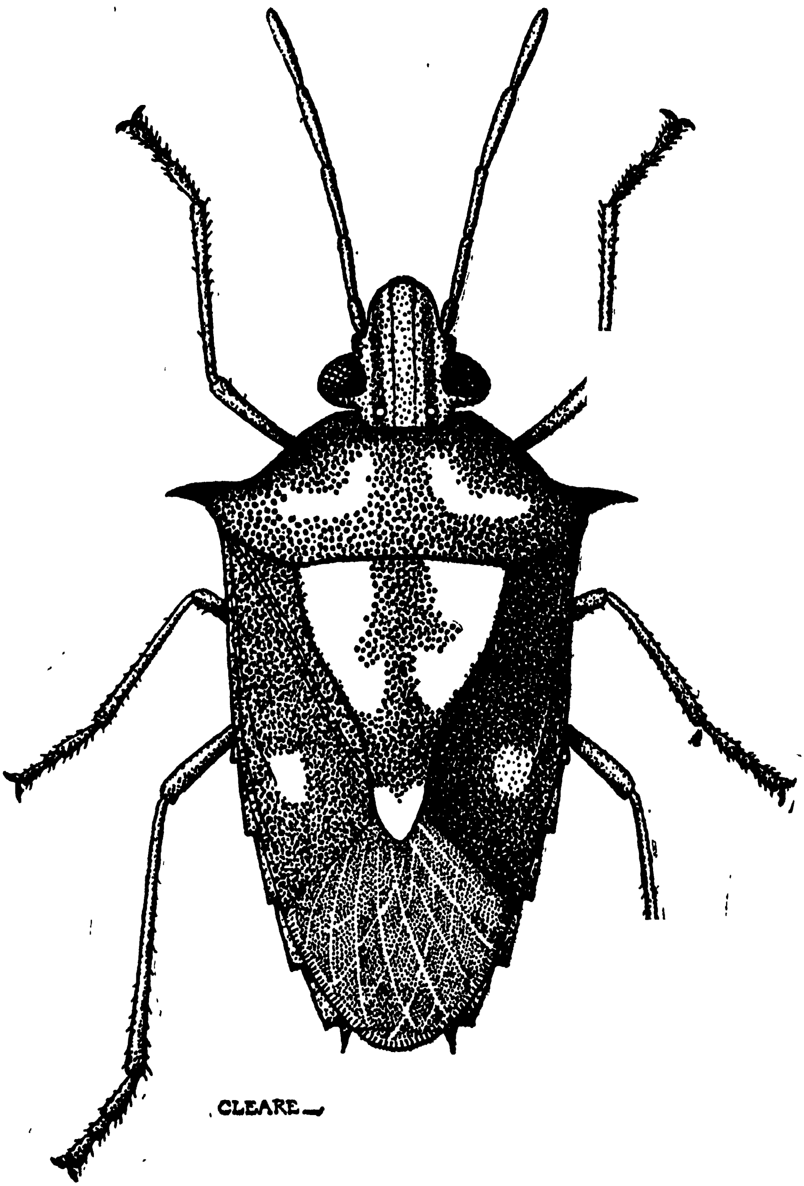


Fig 6.— A typical plant-sucking bug.

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FIG. 7. A group of Aphids or plant-lice on a leaf.

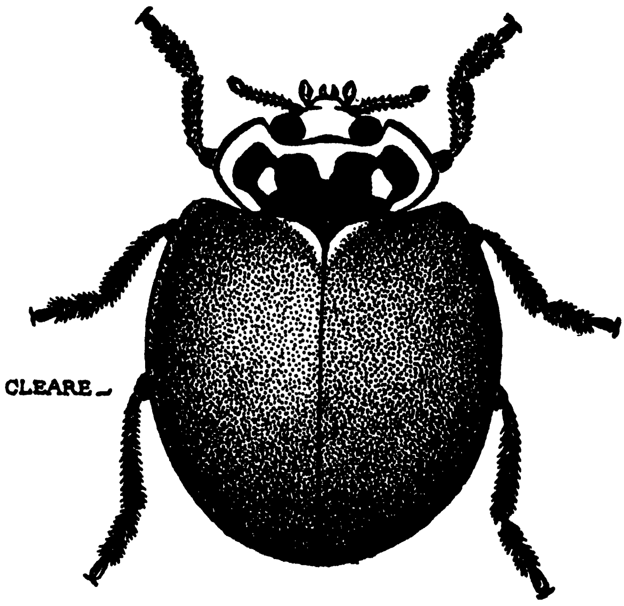

FIG. 8. A lady-bird predaceous on Aphids or plant-lice.

The chemicals mentioned above can be obtained on application to the Department.

DISEASES.

The commonest diseases of vegetables in the Colony are 'damping off' in the seed bed, 'wilts' caused by the attack of some organism on the roots, and occasional moulds or mildews which occur on the portions of the plant above ground during unduly wet weather.

'Damping off' may be due to one or more fungi, but the symptoms are similar, namely, a collapse of the seedlings which shrivel up, turn brown and die. Examination shows that they have been attacked near the soil level by the fungus, and the stem at this point is killed, death of the whole seedling ensuing. The remedy is to ensure good drainage throughout the seed box, and good ventilation among the seedlings, so that the atmosphere is not too damp. The seed must not be sown too close, and while seed beds in the open should be protected from heavy rain by temporary coverings, these should be removed during fine intervals.

'Wilts' are usually caused locally by the attack of fungi of the genus *Fusarium*, commonly found in the soil. Poor soil and bad drainage weaken the plant and favour the attacking fungus. In some cases also certain varieties of the vegetable in question are more hardy and less liable to the disease than others. Use of such

varieties and good cultivation are therefore the first remedies to be attempted. A susceptible vegetable also should not be grown repeatedly on the same plot of land, as the soil is thus liable to become heavily infected with the fungus.

Another root disease, known as Root Knot, is caused by an eel worm, *Heterodera radicicola*, and can prove very destructive. It has only been observed on one or two occasions in the Colony, on sandy soil. Plants that are attacked become stunted and sickly, and may ultimately die. On lifting, the roots are found to be covered with nodules and swellings within which the eggs of the nematode are laid and hatch *in situ*. Later the worms escape and infect the soil. Control of the disease may sometimes be obtained in small beds by heat sterilization of the soil. Starving the worms by a fallow period or planting an immune crop may be effective, or the sowing of a very susceptible crop as a 'trap crop' which attracts the larvae, and is pulled or ploughed out and destroyed before they mature, is also recommended.

Moulds and mildews on leaves and fruits are usually the result of abnormally wet weather conditions. Proper choice of season for planting is the remedy.

Another type of disease which may be mentioned here, though fortunately not very common except on tomatoes, is *Mosaic*. This is caused by a virus, an infectious substance contained in the sap of the plant itself, and very easily transmitted among susceptible plants, either by sucking insects, or even by the fingers of persons handling the plants. The symptoms vary, but usually include a curling up of the leaves and the appearance on them of a yellowish mottling or blotching. In some cases the plants are not attacked until the crop is nearly ready, in which instance little harm is done. The remedies are the use of resistant varieties, and the immediate removal and destruction of affected plants as soon as they show symptoms of the disease.

The specific diseases attacking certain vegetables under local conditions may now be dealt with.

Lettuce.—The only disease observed hitherto on this crop is Root Knot.

Onions.—In very wet weather these are sometimes attacked by a downy mildew—*Phytophthora* sp., the shoots becoming covered with a weft of fungal hyphae and shrivelling up. As with other diseases of this nature, due to excessive humidity, sunlight and dry air are the most effective remedies.

Tomatoes.—The two commonest diseases are 'wilt' and 'blossom-end rot'. 'Wilt' is due to a soil fungus, *Fusarium Lycopersici*. The plants wither and die, and on cutting open the root, the central tissues are seen to be blackened and dis-

coloured. It is a source of trouble in most countries in which tomatoes are grown. Successful results have been obtained in some places by the use of certain varieties which are resistant to the disease, but unfortunately a variety resistant under the conditions prevailing in one locality, may fail in another. Under local condtions, however, the variety *Early Market* has been found fairly resistant. The fungus is favoured by heavy and poorly drained soils, so that every attention should be paid to drainage, and to keeping the soil in the beds in as friable a condition as possible. Should any beds become badly affected by the disease, these should be used for planting different crops for the next few seasons. Under greenhouse conditions sterilization of the soil is sometimes practised, but in the field this is a difficult matter.

'Blossom-end Rot' is a very common complaint locally, and is likewise of world-wide occurrence. The cause of the disease is considered to be closely associated with the water supply of the plant. The disease affects ripening fruits, at the 'blossom-end' of which a small brown patch appears, this may extend and form a starting point for the attacks of insects and fungi. On cutting open, the top half of the fruit is found to be soft and rotted. To prevent the disease, every effort should be made to make the water supply to the plants as regular as possible. Excessive watering is to be avoided. In dry weather the soil should be mulched, and if the plants appear to be suffering from the sun at mid-day, light shade should be provided, by use of muslin, or palm leaves.

Leaf Mould Disease of tomato foliage sometimes occurs in wet weather. It is caused by a fungus, *Cladosporium fulvum*. The upper surface of the leaves show yellow patches, which later turn brown, and the fungus itself may be seen forming velvety patches, grey to brown, on the lower surface. Dry air and sun are the most effective remedies.

Tomatoes are also sometimes affected by Root Knot Disease, and are often attacked by Mosaic. As regards the latter disease, the variety *Early Market* is resistant to this also. The disease is only serious, however, when the plants are attacked before fruiting.

Egg Plant or Boulanger.—The variety with round fruit is occasionally affected by a wilt disease, the causal organism of which has not yet been identified. The symptoms resemble those of Tomato Wilt, and the remedies suggested for that disease are applicable in this case also.

FACTORS INFLUENCING QUALITY.

The principal factors influencing quality may be considered under two heads: (a) Production; (b) Preparation for market.

HINTS ON VEGETABLE CULTURE.

In producing vegetables, the factors of major importance are varieties, cultural practices, enemies, harvesting. From the market standpoint, the product ought to be attractive in colour and appearance, free from blemishes and bruises and to possess good table qualities. Some of the most useful work conducted by the Department at Sub-station Cecilia and other stations is the accumulation of information on varieties best suited to local conditions and markets. In this Colony where conditions are not always ideally suited to vegetable production, the cultural practices of the grower are an important factor in the success or otherwise of truck gardening. Where sand reefs are not available clay soils have to be lightened or so thoroughly cultivated as to keep the surface soil in fine texture. Drainage has to be planned and maintained with the utmost care. Different vegetables demand different practices ; for example, onions must not be moulded ; tomatoes, if good crops are to be obtained, must be pruned. With our pronounced dry seasons mulching must be judiciously practised ; windbreaks should be established.

The enemies, including pests and diseases, already dealt with of vegetables are numerous and a close watch must be kept to ensure that the grower does not lose the reward of his labour as a result of defoliation or damaged and imperfect specimens. The control methods recommended should be put into operation just as soon as the presence of any pest or disease is suspected. If there is any doubt an Agricultural Officer should be consulted promptly. It must be remembered that while the damage caused by insects and disease may not completely destroy the value of the product, such damage affects the quality and invariably results in lower prices.

There are few factors more important than the method of harvesting and the time at which this is done. Thus, in tomatoes, size and colour are important ; in the case of lettuce, cucumbers, cabbage and similar greens, crispness and succulence are the hall mark of quality. To secure this, such vegetables—indeed all garden produce—must be gathered at the right stage of maturity and preferably during the cool part of the day, not put in the sun and, if short storage is necessary, kept in a cool cellar.

The second main factor influencing quality is preparation for market. In this connection, washing, sorting, curing, are all factors which must receive careful attention. Thus, lettuce and root crops (beet, carrots, etc.) must be washed ; dirt and any insects removed and a fresh look ensured. Produce must be sorted or graded so that good quality is not mixed with inferior quality, the result will be better prices for the higher grade products, whilst corresponding prices can be demanded for the lower grade grouped products. In a few vegetables such as onions, curing after harvesting is an important procedure. Another consideration in regard to preparation for market is that of packing and the packages used. A strong, neat, attractive package suitably labelled at once creates interest from prospective buyers. It is, of course, essential that delicate vegetables should not be bruised unduly and that packages with adequate provision for ventilation should ~~not~~ be used.

SEED STORAGE AND SUPPLIES.

The storage of vegetable seed from one crop to another and the maintenance of a high percentage of viability is a problem, the solution of which offers considerable difficulty in the tropics.

Various practical experiments with storage have been made by the Department and the most successful results have been obtained by storing seed in wooden air-tight and insect proof boxes. The lid of the box is lined with rubber and is closed by four thumb screws; this makes it as nearly air-tight as possible. Seed, before being stored in this manner, should be carefully air-dried under shade. The box should be kept in a dry and cool place.

Small farmers, however, may not always find it possible to keep seed in this manner and arrangements have been made, when the Department is not able to supply their seed requirements, for Messrs. Booker Bros., McConnell & Co., Ltd., and Messrs. Brodie & Rainer Ltd., to stock regular supplies of seed of those varieties of vegetables which have been found to give the best results in this Colony. Even when seeds have to be kept at home a short time before sowing it is essential that they be placed in some air-tight container and not left in open vials or boxes.

MONTHLY GUIDE CALENDAR.

January.

Heavy rains. Stake and prune tomato plants sown in November to two stems and pinch out the side laterals but do not remove any leaves, Sow radish broadcast. Kohl Rabi and carrots will be about ready for reaping. Plant peas and beans.

February.

Light showers expected. Tomatoes will now be fruiting. Pick regularly peas and beans to prolong cropping period. Weed onions and keep soil loose, but do not mould up the bulbs. Cauliflowers will be flowering and cabbages heading.

March.

Little rainfall. Fork beds and dig drains. Reap sweet corn planted in December. Cobs must be picked as soon as tassel withers. Onions maturing. Plant bananas, plantains, yams, tannias and cassava.

April.

Light showers. Complete planting of bananas, plantains, and root crops, also plant potatoes, eddoes, corn, melons and cucumbers. Sow vegetable seeds for transplanting later.

May.

Heavy rains. Suitable for transplanting and supplying. Plant peas and beans, choosing early and late varieties for crops to follow in succession.

June.

Heavy rains. Weed plots and keep drains open.

July.

Rainfall lessening but still heavy. Weed plots and mould plants. Sow leguminous green manure crops to improve the fertility of worn-out soil ; cow peas, canavalia and Bengal beans are suitable.

August.

Weather showery but becoming dry. General weeding. Mulch with stable manure or other available material.

September.

Weather dry. Reap sweet potatoes ; if left in the ground to become over-ripe they are likely to be attacked by worms. Ochroes can be planted.

October.

Weather dry. Clean up, fork and leave ground in a rough condition ; plant cassava, tannias, pumpkins and squash. Prepare to sow seed of onions, cabbages, tomatoes, cauliflower, etc. Crops will require watering.

November.

Showery. Complete sowing of the following seeds : tomatoes, onions, cabbages, cauliflowers, beet, Kohl Rabi, carrots and boulangers. Reform beds and dig drains.

December.

Rains. Plant out seedlings and examine for caterpillars. Plant peas and beans also eddoes and corn.

INDEX.

REPORT ON AGRICULTURAL CONDITIONS IN THE RUPUNUNI DISTRICT AND PAKARAIMA MOUNTAINS.

BY

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CONTENTS.

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(1) INTRODUCTION.

This report describes the impressions gained by the two agricultural officers who accompanied the League of Nations Commission to the Rupununi District and the Pakaraima Mountains. It also contains the results of analysis of the few samples of soil and pasturage which it was possible to collect and convey to Georgetown.

The objects of the tour were :—

(a) To obtain, in advance, information regarding the agricultural possibilities of the area for submission to the Commission on the spot;

(b) To accompany the Commission, at a later stage, in order to give opinions on the areas inspected.

The advance party left Georgetown on October 18th. Owing to low water and obstructions in the upper Demerara River together with transport difficulties at Kurupukari and the unexpectedly early start by the main party it was not found possible to proceed beyond Yupukari before the members of Commission arrived.

Samples of soil and pasturage from the Rupununi District previously examined by the Chemical Division showed marked deficiencies of lime and of phosphate. Two field test kits were provided namely *Soiltex* to measure the soil reaction and the *Lamotte-Truog phosphate kit* which gave an estimate of the readily available phosphate in the soil. Numerous tests were made with these outfits in the field and their use not only afforded valuable information on the spot but reduced considerably the number of soil samples deemed necessary to collect and transport to Georgetown.

The areas visited are described in the following five sections of this report.

(2) NORTHERN SAVANNAHS OF THE RUPUNUNI DISTRICT.

The northern savannahs, bounded by the Kanuku Mountains on the south, by the Rupununi River on the east, Takutu River on the west and the Pakaraima Mountains on the north, have an approximate area of 2,000 sq. miles. Considerable stretches are flooded during wet weather for periods varying from three days to three weeks. In this area the grazing rights have been leased to a number of settlers who run their cattle on the open range system.

The flat savannah country in the vicinity of the Annai hills mainly consists of acidic clays or silts mixed with a small amount of sand and as a rule supports a considerable amount of sedge. It is usually flooded or water-logged during the wet season. At the base of the hills where the soil is sandier and the land never floods the herbage appears to be better, but such areas are limited. The hill slopes are rocky and present little soil surface.

The soil samples tested in this vicinity had an acidic reaction and the majority contained only traces of readily available phosphate. One sample of a red brown clay, collected by Dr. Grantham from a valley behind the first range of hills to the north of Annai, had a reaction of pH 6.4 and a readily available phosphate content of 15 p. p. m. Such a soil should be capable of supporting fair crops. Experience has indicated that more fertile soil is usually found at the foot of slopes of northern aspect and it is possible that fertile areas exist in the valleys of the hills north of Annai. Circumstances did not permit of much investigation in this direction.

The northern savannahs as traversed from Toca to Karanambo and from Yupukari to Bon Success consist of gently undulating orchard bush and swampy flats. The predominating tree in the open savannah is the caiambai or

saddle tree (*Curatella Americana*) while the swamps and water courses are marked by stands of Ité palms. The view is always broken by trees either on creek banks or in bush islands. The elevated soils usually fall into two main classes (a) a highly acidic grey or buff sandy topsoil which merges into a highly acidic clay loam subsoil of pinkish colour and (b) a highly acidic red clay topsoil often covered with a layer of ironstone gravel and resting on a highly acidic red clay subsoil. The soils of the swampy flats consist of pale coloured sands, silts or clays often covered by a thin layer of acid organic matter. The open savannahs are for the most part, sparsely covered with clumps of grass (chiefly *Trachypogon plumosus*) which appear to contain a considerable amount of roughage unless freshly burnt.

An example of the topsoil occurring on the elevated land of the northern savannahs is given by sample E. 365. The results of its analytical examination are presented in Table I.

TABLE I.

	E. 365
Normal reaction, pH	5.57
Exchange reaction, KCl pH	4.55
Soluble salts %	0.007
Organic matter %	0.33
Nitrogen %	0.026
Carbon : nitrogen ratio	7.35
Readily available phosphate, p.p.m.	10
Index of texture	0
Rate of solution	5
Exchangeable bases*	
Lime	0.13
Magnesia	0.12
Potash	0.06
Soda	0.07

The soil is a markedly acidic light sand containing only small amounts of organic matter and exchangeable bases. The amount of readily available phosphate is low and the value for the rate of solution suggests that the soil is not particularly fertile.

A sample of *Trachypogon plumosus* collected in the vicinity gave the analytical figures presented in Table II.

*The exchangeable bases were obtained by leaching the soil with semi-normal acetic acid. The values reported for these and subsequent samples may therefore include substances soluble in water or in the extracting agent.

TABLE II.

Per cent. Oven dry weight.

Total ash (sulphated)	10.8
Silica-free ash	1.0
Lime	0.14
Phosphate	0.03
Potash	0.40

The contents of silica-free ash, lime and potash and phosphate are very low. There are certain areas in the savannah known as bush islands, small knolls where the forest covering has so far withstood the effects of fire. An example of the topsoil of a bush island in the southern savannah is given by sample E, 370, The results of its analytical examination are given in Table III.

TABLE III.

	E. 370
Normal reaction, pH	5.82
Exchange reaction, KCl pH	5.12
Soluble salts %	0.018
Organic matter %	1.71
Nitrogen %	0.099
Carbon : nitrogen ratio	9.92
Readily available phosphate, p.p.m.	10
Index of texture	1
Rate of solution	125
Exchangeable bases	
Lime	1.06
Magnesia	0.57
Potash	0.15
Soda	0.02

The soil is a slightly acidic light sand possessing a fair amount of organic matter. The amount of readily available phosphate is low. The values for exchangeable bases and for the rate of solution suggest that this soil is more fertile than that of the open savannahs.

The streams flowing from the Kanuku Mountains are turbid and the water is alkaline, neutral or slightly acidic in reaction. It is to be expected that the soils along the margins of these streams would be slightly superior to those of the open savannah. These areas are however limited and require protection from cattle.

Throughout the northern savannahs the only cultivations encountered are either within bush islands or within fenced areas usually the site of old cattle corrals.

The soil within the bush islands appears to be slightly more fertile than that of the open savannahs and since it is comparatively easy to protect cultivation within these islands from cattle a number of farms are found in such situations. The bush is felled and burnt and a crop of corn is taken off. Cassava is then planted and the farm is afterwards abandoned. The first crop is good and excellent heads of corn obtained from such farms were to be seen in most ranch houses. The second crop is usually poor. The reported yields varied to such an extent that no reliable figures can be quoted.

The soils of the open savannah are poor and cannot be planted unless they are protected from cattle. The difficulty is overcome by planting in disused cattle corrals. Two or more corrals are built near the ranch house and all the milch cows, pack oxen and horses are driven into these enclosures. The corrals are manured in this way for a period of three months or more. They are then ploughed and planted to cassava, tobacco, sweet potatoes and corn. A good crop can be obtained in this fashion but here again the reported yields vary considerably. Cassava is the principal crop cultivated and although it might be lifted at nine months it is generally considered better to reap it at twelve months. Two successive crops are occasionally taken but the final yields are usually disappointing and it is considered better practice to turn cattle into the corral again after one crop has been obtained.

These two types of cultivation are suited to the savannah soils and no immediate improvements can be envisaged other than by experiment with different varieties of corn and cassava.

The possibilities of cultivation along the banks of the many perennial streams found in the savannahs deserve further investigation. Many areas appeared to offer distinct opportunities for padi.

At Karanambo, the homestead of Mr. E. M. McTurk, there is a fenced compound of red sand with considerable quantities of ironstone gravel. Water, obtained from the Rupununi River by means of a windmill, is piped all over the compound and very good grapefruit, limes, lemons and oranges are established. Several good pineapple plants of the Smooth Cayenne variety were noticed in an abandoned corral. Pigs and poultry seemed to be in good condition and there are twenty-one hives of bees producing a pleasant-flavoured honey. Other residents in the district, such as Mr. B. L. Hart and Mr. J. Melville, have fenced compounds round their homesteads and in these areas, which are liberally manured by the livestock, orchard crops and kitchen gardens can be successfully established especially where a supply of irrigation water is at hand.

Specimens of marl were inspected in the Government compound at Bon Success. It occurs as small nodules lying on the surface of slight depressions which are flooded during the wet season. By the banks of the Tabatinga creek erosion has exposed poor grade marl containing 48.1 per cent. calcium carbonate. The deposit does not appear to be of commercial importance.

(3) THE FOOTHILLS OF THE KANUKU MOUNTAINS.

Several excursions were made to the foothills of the Kanuku Mountains. On the *north western* side of this range, the mountain slopes are steep and covered with boulders and outcrops leaving little actual soil space. The agricultural possibilities of these slopes are limited since any attempt at clearing would probably be followed by considerable soil erosion.

The soils of the valleys and the foot of the slopes possess undoubted agricultural possibilities but appear, as far as it was possible to ascertain, to be of limited extent. Samples Nos. E. 366 and 367 represent this soil type which consists of an alkaline, neutral or slightly acidic red brown clay loam washed down from the mountains. The results of the laboratory examination of these samples are given in Table IV.

TABLE IV.

	E. 366	E. 367
Normal reaction, pH	7.54	7.16
Exchange reaction, KCl pH	7.35	6.92
Soluble salts %	0.053	0.025
Organic matter %	2.86	1.86
Nitrogen %	0.222	0.142
Carbon : nitrogen ratio	7.42	7.55
Readily available phosphate, p.p.m.	38	12
Index of Texture	34	13
Rate of solution	220	66
Exchangeable bases		
Lime	12.81	5.74
Magnesia	3.46	1.37
Potash	0.64	0.26
Soda	0.20	0.26

Sample E. 366 is a slightly alkaline red brown clay loam well supplied with organic matter, lime, potash and readily available phosphate. The value for the rate of solution suggests a high level of fertility. It is an example of the best agricultural soil encountered in the Rupununi District. Sample E. 367 is a neutral sandy loam possessing adequate supplies of organic matter, lime, potash and readily available phosphate.

This soil type was first encountered at the head of the Moco-Moco creek and there appeared to be about 600—1,200 acres available in the vicinity.

On a farm in the neighbourhood corn and cassava were the principal crops. They were of excellent quality and were giving high yields. Some parts of the farm were supporting second crops of corn and cassava which promised heavy returns. Bananas were better than any seen on the coastlands, while pawpaws, black eyed peas, Arabian coffee, hill padi, sugar cane and cotton were doing exceedingly well. The drainage of the area was excellent, there being a gentle slope down to a creek at the hill foot.

Such a soil would be eminently suitable for settling small-holding farmers. Shifting cultivation had been practised in this valley, but there is no reason why the soil should not stand up to continued cultivation if properly worked.

Another example of this soil type was discovered at the head of the Burro creek. Sample E. 368 is a composite of the soil occurring on Mr. E. Melville's farm in this vicinity. The results of its laboratory examination are given in Table V.

TABLE V.

	E. 368
Normal reaction, pH	6.15
Exchange reaction, KCl pH	5.56
Soluble salts %	0.020
Organic matter %	2.66
Nitrogen %	0.193
Carbon : nitrogen ratio	7.95
Readily available phosphate, p.p.m.	10
Index of texture	14
Rate of solution	131
Exchangeable bases	
Lime	2.42
Magnesia	0.98
Potash	0.37
Soda	0.26

The sample is a slightly acidic sandy loam, well supplied with organic matter. It possesses a fair amount of lime and an adequacy of potash. The content of readily available phosphate is low. The figure for the rate of solution suggests that the soil is of fair fertility.

The soil of the eastern half of the farm was an orange loam while that of the western half, where the hill forest gives way to the savannah, was a black,

fine sandy soil. The farm was situated about half a mile from the foot of the mountains.

The owner stated that the farm gave excellent yields of cassava, corn, sweet potatoes, guinea corn, padi and vine crops such as squash and pumpkin. Yields were not given but appearances suggested that the returns were not quite as heavy as those obtained at the Moco-Moco head.

The guinea corn was of the open-panicle type which is extensively grown in West Africa and there forms a staple of diet. The yields of this corn were good and the appearance of the crop compared favourably with that seen in Northern Nigeria. It is evidently a crop which would do well in the Rupununi District where the long dry season ensures ripening.

The padi crop, grown on rainfall alone, was exceptionally good. Two varieties, both imported from Brazil, were noted. The one, a white or pale golden glumed variety had given a yield estimated at between 3,000—3,700 lbs. per acre with wide spacing. Closer planting would have resulted in increased yields. The crop had been corn-planted and had tillered heavily. The ratoon crop presented a good appearance and promised a yield of about 1,500 lbs. per acre. This variety does not shatter easily, keeps well and makes a very good white rice. The grain is of the Carolina type but is not quite so large. The other variety, which does not yield so heavily, is black glumed and of the barley type. The grain is softer, does not keep well and produces an inferior quality of rice due to considerable breakage on milling. Further disadvantages are its failure to ratoon and its susceptibility to attack by birds. Arrangements have been made to obtain a sample of the white glumed variety for examination in Georgetown. Both varieties seen in the cultivation were very pure, no red grain or awned wild types being observed.

The cultivation of padi in the Rupununi is worthy of further investigation. The present price in the district is 80 lbs. for $1.20. Increased production would add variation to the somewhat monotonous diet of farine and tasso.

It is probable that promising soil exists in all the numerous valleys of the north-western section of this mountain range. Circumstances did not permit the exploration of the wide valley at the Inaga creek head, but such an area is worthy of investigation.

The soils of the foothills of the southern side of the Kanuku Mountains do not seem to possess the degree of fertility associated with those of the north-western foothills, but are preferable to those of the open savannahs. Sample E. 369 represents the soil found on an abandoned farm at the mouth of the Saurap valley, the results of its laboratory examination are given in Table VI.

TABLE VI.

	E. 369
Normal reaction, pH	6.58
Exchange reaction, KCl pH	6.30
Soluble salts %	0.023
Organic matter %	2.89
Nitrogen %	0.206
Carbon : nitrogen ratio	8.09
Readily available phosphate, p.p.m	10
Index of Texture	18
Rate of Solution	215
Exchangeable bases	
Lime	9.05
Magnesia	2.35
Potash	0.25
Soda	0.15

The soil is a slightly acidic sandy loam. It is well supplied with organic matter, lime and potash. The supplies of readily available phosphate are low. The figure for the rate of solution suggests that the soil is of fair fertility. It resembles that found at the Moco-Moco head but contains less available phosphate.

In its upper reaches the Saurap opens out into a wide valley with extensive flats of acid clay, a possible area for padi cultivation since the creek might be used for irrigation purposes.

A further sample of the soil at the foothills of these mountains was obtained beside the Toroquara creek, some fifteen miles from Wichabai. The results of its laboratory examination are presented in Table VII.

TABLE VII.

	E. 371
Normal reaction, pH	5.37
Exchange reaction, KCl pH	4.77
Soluble salts %	0.015
Organic matter %	1.66
Nitrogen %	0.085
Carbon : nitrogen ratio	11.21
Readily available phosphate, p.p.m	10
Index of Texture	11
Rate of solution	42
Exchangeable bases	
Lime	0.89
Magnesia	0.65
Potash	0.21
Soda	0.12

It will be seen that this soil does not resemble the fertile brown loam of the north-western foothills.

The soil is a markedly acidic brown sandy loam. It possesses an average amount of organic matter. The quantities of lime and readily available phosphate are low. The amount of exchangeable potash can be considered adequate. The figure for the rate of solution suggests that the soil possesses some fertility. The soil should be capable of supporting fair crops of swamp padi. Irrigation water could be obtained from the Toroquara creek. Protectional fencing would be required.

The hill slopes in the vicinity of the Darukuban Mountains are very steep and rocky and offer little prospects of cultivation. Two soil samples E. 372 and E. 373 were obtained on the flats in the neighbourhood of the mountain. The results of their laboratory examination are presented in Table VIII.

TABLE VIII.

	E. 372	E. 373
Normal reaction, pH	5.70	5.74
Exchange reaction, KCl pH	4.80	4.93
Soluble salts %	0.026	0.011
Organic matter %	1.32	1.19
Nitrogen %	0.068	0.065
Carbon : nitrogen ratio	11.15	10.50
Readily available phosphate, p.p.m.	10	10
Index of Texture	6	9
Rate of solution	24	38
Exchangeable bases		
Lime	0.91	1.46
Magnesia	0.57	1.24
Potash	0.16	0.19
Soda	0.22	0.16

The soils are markedly acidic sands. The amounts of organic matter, potash and readily available phosphate are low. The possibilities of cultivation are small.

(4) SOUTH-WESTERN SAVANNAHS OF THE RUPUNUNI DISTRICT.

The tour of the south-western savannahs included visits to Shiriri Mountains and the Kusad Mountains. The description given of the *northern* savannahs of the Rupununi applies, in many respects, equally well to the south-western savannahs. The actual savannah seems to be more subject to inundation and even less likely to offer possibilities of cultivation. Both in the northern and southern savannahs the impression is gained that the basin of the Rupununi is

less liable to inundation than the basin of the Takutu River. There are several isolated hills and mountains and at the foot of their northern slopes limited patches of fairly fertile soil are to be found. On the north-eastern side of Shiriri Mountains, where the savannah gives way to the foothills, there is a patch, approximately six acres in area, of brown loam of neutral reaction and containing 15 p.p.m. of readily available phosphate. A sample of the pasture supported by this soil was taken for analysis. The results obtained are presented in Table IX.

TABLE IX.

Per Cent. Oven dry weight.

Total ash (sulphated)	11.1
Silica-free ash	2.4
Lime	0.24
Phosphate	0.15
Potash	0.50

The contents of silica-free ash, phosphate and potash are low. The amount of lime, while still low, is higher than that found in other samples of savannah pasturage examined. It was often noticed that the horses when grazing, would select a small leguminous plant (*Desmodium?*). A sample was collected on the foothills at the base of the Shiriri Mountains and the results of its laboratory examination are presented in Table X.

TABLE X.

Per Cent. Oven dry weight.

Total ash (sulphated)	15.7
Silica-free ash	15.0
Lime	5.00
Phosphate	0.39
Magnesia	0.80
Potash	1.38

The contents of silica-free ash and lime are very high, those of magnesia and potash are of an average value while the phosphate content is higher than that found in any of the pasture samples so far obtained from the savannahs.

Only one Indian farm was seen in the neighbourhood of the Shiriri Mountains though two or three patches of secondary bush marked the sites of abandoned farms at the mountain foot. The owner stated that the depredations of cattle had caused him to abandon the hill-foot and his present cultivation is to be found on the very steep, boulder-strewn slope of the mountain. Trees had been felled and burnt and the soil, a highly acidic red clay, had produced a crop of

corn and was supporting a mixed cultivation of cassava, melons, pumpkins, pawpaws, cotton and a little tobacco. Yields appeared to be poor. The area is limited and there is a danger of considerable erosion if more of the present forest covering disappears. There are some small patches of heavy clay soil in the valleys which might be utilised for swamp padi cultivation. No irrigation facilities exist as there appear to be no perennial streams, but the areas are swamped or water-logged in the wet season. With the exception of the patch of good soil on the north-east of the range the agricultural possibilities of this area are unpromising.

On the way from Shiriri Mountains to Kusad Mountains and after crossing Capooti creek the trail passed through treeless savannah. The soil consisted of a floury white sand. Well-defined cattle tracks lead to small bare patches where thin crusts of salt were noticed. The top one-inch layer of the soil contained a noticeable amount of salt and a sample, E. 374, was collected. The results of laboratory examination are shown in Table XI.

TABLE XI.

	E. 374
Normal reaction, pH	6.85
Exchange reaction, KCl pH	6.85
Soluble salts %	2.642
Organic matter %	—
Nitrogen %	—
Carbon : nitrogen ratio	—
Readily available phosphate, p.p.m	12
Index of Texture	7
Rate of solution	1636
Exchangeable bases	
Lime	3.48
Magnesia	17.50
Potash	0.04
Soda	39.4

The top one-inch layer contains 2.64 per cent. of soluble salts consisting mainly of sodium chloride. A certain amount of magnesium chloride is also present.

The soil at a depth of twelve inches did not appear to contain a noticeable amount of salt. A sample of the white crusts was obtained for analysis. The results are presented in Table XII.

TABLE XII.

Per cent. Oven dry weight.

Chlorine (Cl)	40.6
Sodium (Na)	26.8
Sulphate (SO_3)	0.14
Lime (CaO)	Trace
Magnesia (MgO)	0.08
Matter insoluble in water	32.3

The crusts consist of almost pure sodium chloride mixed with white sand.

It is understood that Indians, in former times, used to collect the top layers of this soil for the manufacture of salt. At the present time cattle and horses visit these salt licks.

The western slopes of the Kusad Mountains rise steeply in boulder-strewn slopes from the savannah of loose sandy soil. There are no foothills and the savannah appears to be water-logged, if not completely submerged, during the rainy season. The northern slopes of north-western aspect possess a slightly acidic, reddish-brown sandy loam soil (pH 6.4) lying between boulders. This soil resembles that situated on the north-western slopes of the Kanuku Mountains. A fair-sized valley in the vicinity contains good soil presumably the result of hill wash. Sample E. 375 is representative of this area and the results of its laboratory examination are shown in Table XIII.

TABLE XIII.

	E. 375
Normal reaction, pH	5.60
Exchange reaction, KCl pH	5.00
Soluble salts %	0.020
Organic Matter %	2.34
Nitrogen %	0.114
Carbon : nitrogen ratio	11.81
Readily available phosphate, p.p.m.	15
Index of texture	—
Rate of solution	207
Exchangeable bases	
Lime	5.65
Magnesia	2.04
Potash	0.20
Soda	0.22

The soil is a slightly acidic brown loam possessing fair supplies of organic matter, lime, potash and readily available phosphate. It is similar to that en-

countered at the Moco-Moco head and should be capable of supporting continuous cultivation. It is possible that other northern valleys of this range possess areas of good soil. Time did not permit further investigation.

Other salt pans were encountered during the journey from Kusad Mountains to the Sauri-wau.

(5) KURASABI AND IRENG VALLEY.

The Kurasabi reserve possesses an extensive savannah which is isolated from the main savannahs by mountains and the Ireng River. While the soil of the open savannah does not appear to differ markedly from that of the Rupununi savannah yet the pasturage is better and in most parts forms an almost complete cover. The cattle in the reserve are tame and in good condition, due probably to the fact that they are not being continually rounded up.

The inhabitants of Kurasabi village have their cultivation in the Yurora creek head where the soil is reported to be of fair fertility. Time did not permit a visit to this area.

A sample of soil, E. 376, was collected from the middle of the open savannah and the results of its laboratory examination are shown in Table XIV.

TABLE XIV.

	E. 376
Normal reaction, pH	5.54
Exchange reaction, KCl pH	4.64
Soluble salts %	0.012
Organic matter %	1.05
Nitrogen %	0.052
Carbon : nitrogen ratio	11.59
Readily available phosphate, p.p.m.	10
Index of texture	1
Rate of solution	84
Exchangeable bases	
Lime	0.16
Magnesia	0.35
Potash	0.23
Soda	0.16

The soil is a markedly acidic sand. The contents of organic matter, lime and readily available phosphate are low. The supplies of potash appear to be adequate.

A sample of pasturage from the same area was examined regarding its mineral constituents. The results are given in Table XV.

TABLE XV.

Per Cent. Oven dry weight.

Total ash (sulphated)	9.0
Silica-free ash	1.1
Lime	0.12
Phosphate	0.02
Potash	0.37

The pasturage contains very small amounts of silica-free ash, lime, phosphate and potash.

The mountainous country in the vicinity of the Ireng River, from Kurasabi, through Motukguroo, Tipuru, Simiguroo, Maripakuru to the Echilibar presents varied agricultural opportunities. The majority of the area consists of hills almost covered with quartz or of slopes of ironstone gravel. There are certain patches of promising soil, similar to that encountered on the north-western slopes of the Kanuku Mountains. One considerable area was noted between Motokguroo and Tipuru and was situated on a slope of northern aspect. Isolated patches of heavier soil occur in certain valleys and might be utilised for padi cultivation but would require fencing. Many of the hill slopes are forested and on such areas the present inhabitants practise shifting cultivation. In the proximity of the Ireng River and its tributaries the Kaboura Fly, a Simulium, is prevalent even in the dry season and it is understood that during the wet season its presence makes life most unpleasant.

As regards grazing the Kurasabi savannah is the most important area for it is within easy reach of the cattle trail to Georgetown. The savannah is enclosed by mountains and the Ireng River. The grazing appears to be of better quality than that of the open savannahs and the cattle seen were quite tame and in very good condition. No round-ups are held and consequently the animals are not "run" unnecessarily. Although the savannah is within an Indian reservation a rancher's out-station has been established in the area.

The savannahs of the Echilibar valley were at one time stocked by a rancher who traded his cattle through Brazil. Although the out-station still exists few cattle remain in the area.

(6) PAKARAIMA MOUNTAINS.

Generally speaking the soils of the Pakaraima range are of low fertility and few signs of cultivation are to be noted. The open hills consist of buff coloured sands or loams of acidic reaction and the surface is almost entirely covered with quartz boulders and pebbles. In other places the hills consist of an acidic red clay covered by a layer of ironstone gravel. The mountain tops are usually covered with an infertile white sand and on descending one passes through a belt

of acidic brown sand then a belt of acidic red clay to the creek bed. Many of the mountain slopes are forest covered but here and there elevated savannahs are encountered. Some of these, such as the Echilibar, the Kato and the Chiung savannahs, are extensive.

No ranching is carried on in the Pakaraima savannahs. A very extensive area has been leased to a company in the Kato savannah. No cattle have been placed there and the land cannot be said to be beneficially occupied. On the other hand such grazing might be utilised by Indians.

A few cattle are kept by the Roman Catholic Mission at Santa Maria. They are grazed, for the most part, in the Tumong savannahs. The grazing in the Pakaraima savannahs is as a general rule better than that found in the Rupununi, and the cattle seen were in good condition.

Cattle raising in this area, would however, present definite difficulties in the matter of selling the animals. The whole of the trail, traversed by the writers from Kurasabai to Santa Maria, was difficult, being hilly and mountainous. Added to this there are large stretches of forest in which cattle being driven down to the trail would get nothing to eat. This factor combined with a difficult trail would put the animals into very poor condition. No evidence of cattle disease was observed in the Pakaraima country.

Samples E. 379 and E. 380 were collected from the open elevated savannahs and are typical of this country. The results of their laboratory examination are presented in Table XVI.

TABLE XVI.

	E. 379	E. 380
Normal reaction, pH	4.80	5.07
Exchange reaction, KCl pH	4.23	4.23
Soluble salts %	0.007	0.006
Organic matter %	0.78	0.96
Nitrogen %	0.049	0.060
Carbon : nitrogen ratio	9.23	9.25
Readily available phosphate, p.p.m.	10	10
Index of texture	16	5
Rate of solution	2	2
Exchangeable bases		
Lime	0.16	0.09
Magnesia	0.18	0.16
Potash	0.34	0.11
Soda	0.16	0.43

The soil from the Kato savannah is a markedly acidic sandy loam. The amounts of organic matter, lime and readily available phosphate are low. It possesses an adequate amount of potash. The soil from the Chuing savannah is a markedly acidic sand. The contents of organic matter, lime, potash and readily available phosphate are low.

A sample of pasturage was collected in the vicinity of Paramakatoi and the results of analysis are given in Table XVII.

TABLE XVII.

Per Cent. Oven dry weight.

Total ash (sulphated)	8.3
Silica-free ash	1.7
Lime	0.09
Phosphate	0.05
Potash	0.61

The amounts of silica-free ash, lime, phosphate and potash are very low.

Samples E. 381 and E. 382 were collected from the elevated, forest covered plateau between the head waters of the Tumong River and the Wong River. The results of their laboratory examination are given in Table XVIII.

TABLE XVIII.

	E. 381	E. 382
Normal reaction, pH	4.70	4.83
Exchange reaction, KCl pH	3.87	4.16
Soluble Salts %	0.049	0.044
Organic matter %	6.05	10.30
Nitrogen %	0.341	0.108
Carbon : nitrogen ratio	10.2	54.6
Readily available phosphate, p.p.m.	10	10
Index of texture	46	—
Rate of solution	104	226
Exchangeable bases		
Lime	0.23	0.56
Magnesia	0.28	0.38
Potash	0.43	0.43
Soda	1.01	1.06

The soil collected at the head of the Tumong is a highly acidic red clay, that collected on the plateau between Mikroparu and Chenapowu is a markedly

acidic yellow clay. Both soils are well supplied with organic matter and potash but are deficient in lime and readily available phosphate. While they might produce fair crops under shifting cultivation they are not likely to stand up to continuous cultivation.

Two notable exceptions to the general statement that the soils of the Pakaraimas are relatively infertile were encountered during the journey.

In the broad valley of the Yawong River, between Wandapatoi and Paramakatoi there is a considerable area of exceptionally fertile soil. Samples E. 377 and E. 378 represent this soil and the results of their laboratory examination are given in Table XIX.

TABLE XIX.

	E. 377	E. 378
Normal reaction, pH	8.33	8.06
Exchange reaction, KCl pH	7.97	7.99
Soluble salts %	0.051	0.052
Organic matter %	3.22	3.63
Nitrogen %	0.256	0.288
Carbon : nitrogen ratio	7.25	7.25
Readily available phosphate, p.p.m.	72	10
Index of texture	48	41
Rate of solution	265	280
Exchangeable bases		
Lime	20.94	13.33
Magnesia	2.65	3.58
Potash	0.20	0.34
Soda	0.12	0.21

Sample E. 377 is an alkaline chocolate brown fine silt well supplied with organic matter, potash and readily available phosphate. It contains a very considerable amount of lime. Sample E. 378 is an alkaline chocolate brown heavy silt well supplied with organic matter, lime and potash. It is, however, deficient in readily available phosphate.

Time did not allow of an investigation regarding the extent of this class of soil but it seems likely that it consists of a band some five or six miles wide in the valley of the Yawong river. Its length was not estimated.

Excellent cultivations of mixed crops were seen in this area. The cassava and yams were bigger than those seen anywhere else in the Colony. A number of Indians have cultivated this area for many years. The Yawong valley was the only place on the whole tour where any extensive cultivation was encounter-

ed. The Indians practise shifting cultivation on this soil although it will support permanent farms. Even in abandoned areas yields were better than those obtained in other parts of the Colony.

The other exception is the land on the banks of the Chiung River. This river passes over an area of red soil apparently derived from some basic rock. The river margins, which are somewhat limited in extent, no doubt benefit by depositions of soil washed down from above. The soil consists of a black humic layer to a depth of two inches overlying a yellow clay. The soil is slightly acidic (pH 6.2, soiltex) and contains a considerable amount of readily available phosphate (75 p.p.m.).

(7) DISCUSSION.

Cattle ranching is, at the moment, and is likely to remain the chief agricultural industry of the Rupununi. It is the only occupation, under present transport conditions, which can produce an exportable surplus. In the northern savannahs the grazing rights have been leased to a number of ranchers while in the southern savannahs an area, estimated at 2,500 sq. miles is leased to the Rupununi Development Company.

(a) TYPE OF CATTLE.

Cattle were introduced into the Rupununi savannahs originally from Brazil. They are very mixed as to type, colour, size and shape and little has so far been done to improve the breed. The majority are of a big frame type with large horns. The herds carry large numbers of very inferior scrub cattle which have been raised from poor-type bulls and also by inbreeding. The cattle are as a rule exceedingly wild except in a few cases where herding is practised and they become used to the sight of man.

(b) PASTURAGE.

The pasturage throughout the savannahs varies considerably according to the type of soil. There is however one predominating pasture grass, namely, *Trachypogon plumosus*. This is a grass with a tufted habit of growth which if not grazed, soon becomes coarse and unpalatable and the tufts full of dead leaves. The next commonest grasses are *Axonopus aureus* and *Andropogon angustatus*. In the swampy flats several sedges are seen. Of non-graminous plants the commonest on the savannahs are *Paepalanthus capillaceous* and *Byrsonima verbascifolia*. The whole of the savannah country is covered with orchard bush, the predominating tree being the caiambai or saddle tree (*Curatella Americana*). Cashew trees are also found, usually in groups on the savannah islands.

The pasturage as a whole is poor and judging by the condition of the bulk of the cattle it cannot be very nutritious. The samples examined in the laboratory show a marked mineral deficiency. There is no system of pasture manage-

ment and cattle tend to concentrate where the better grazing is to be obtained. In consequence large areas are left almost untouched.

(c) MANAGEMENT.

The Rupununi cattle ranches are run on the open range system, and no attempt is made at paddocking or rotational grazing. Cattle are turned loose with bulls and round-ups are held twice annually for branding and counting. The cattle are seldom herded and therefore become very wild. It may be said that with few exceptions the cattle ranches are run with no definite system of management as regards the cattle except for the bi-annual round-up and branding. The cattle are left to range by themselves and breeding is entirely haphazard, no selection is practised, and up to fairly recent times castration of young bulls was not carried out. As a result stock was often inbred or got by "scrub" bulls and this has undoubtedly had a very deleterious effect on the type of cattle as a whole.

Closer attention is now paid to the castration of young bulls on most of the ranches, but in some cases castration has been done indiscriminately and there is now a shortage of stud animals. Ranchers consider that one stud bull should be kept to every twenty-five cows.

The Rupununi Development Company have made two large paddocks which they are utilising for running their selected breeding stock with Hereford, Zebu and half-bred Zebu bulls. It is unfortunate that work such as this was not commenced when the Company was formed as they would certainly have a better class of earlier maturing stock to-day. The Zebu bulls were imported from Brazil and are both exceptionally fine animals and in good condition. They are running with selected cattle which have a large proportion of Hereford blood. Four Hereford bulls were originally imported from England, but two died. The remaining two are now running with selected cows. Hitherto these Herefords were running on the open range, a system not to be recommended as imported pedigree stock requires care and attention. Such a proceeding is wasteful since the bulls may serve poor type cows and only get "scrub", half-bred stock. Furthermore losses of calves may occur. With the present system, good type half-bred bulls can be selected and reared to run on the range with the herd at a later stage. At the present time it takes from six to seven years to mature and condition a Rupununi steer and it is estimated that Hereford steers mature in three and a half to four years. The Rupununi Development Company are aiming to breed with the local stock a strain having a quarter Hereford and an eighth Zebu blood. The Zebu blood is needed to give stamina as the white faces do not stand the trail well.

The production of calves as shown by the brandings is low. Only fifty per cent. of the breeding stock rear calves. This is attributed by some to the poor type of the cattle and the fact that they do not breed. This opinion is

not supported by the experience of the Indians owning cattle who rear eighty to ninty per cent. calves from their breeding stock. The result is attributed to the fact that their cattle are tame. Ranch cattle are very wild and will run for long distances on being alarmed. The effect of frequent stampedes on young calves may well be imagined. It is believed also that cows heavy in calf abort during a stampede and losses occur in this way. Calves born in the rainy weather have little chance of living as much of the ground becomes swampy and soft. Cramp attacks young calves and many of them get bogged in swampy places.

One of the great disadvantages of the open range system as practised in the northern savannahs is that if a rancher wishes to cut out his own steers it is necessary to round-up and drive off the cattle belonging to two or more other ranchers. Individual handling is of course impossible with a large number of cattle, but if herding were practised and the cattle were treated a little more quietly an improvement would be effected. When the cattle are not run or scared by vacqueros they soon become tame.

Milk production is very low, only averaging two pints per day per cow, which is not sufficient to rear strong healthy calves, especially under present conditions.

There are many faults to be found with the present ranching system of the Rupunuui District and it is comparatively easy to suggest improvements, but it has to be remembered that the present system of management (or rather lack of it) is due entirely to economic conditions and not to slackness, and lack of interest or ability on the part of the ranchers. The price of cattle to-day in Georgetown is low and ranchers cannot afford a big capital outlay for such matters as fencing paddocks. Improvements could, however, be effected with the breed. This would only need a small capital outlay on imported bulls and would require care in selecting breeding stock and herding them around the ranch house corrals.

It has been stated that the Rupununi savannahs are understocked and that the pasture would be improved by heavier grazing. This is considered a debatable point and only by definite grazing experiments could it be proved or disproved. It is true that on going through the country large areas are noticed which are undergrazed and in these areas the grasses become dry and unpalatable. However, it seems, even taking into account the nature of the poor type of stock, that the actual condition of the animals should be better if there is an excess of good grazing. Steers selected for marketing have the appearance of being in good condition but they are not "prime" and on killing there is an almost total absence of fat. It may be mentioned here that the beef is of excellent quality. It is tender, and of very good flavour, though rather coarse in grain and dark in colour. The fact that there is a large acreage available allows of the practice of burning the savannahs. This destroys the tough and unpalatable grasses and

later gives rise to a fresh spring of young green grass on which the stock feed. There are many arguments for and against the burning of pastures. Indiscriminate burning may have damaged certain areas, but generally speaking no ill effects were noted in grazing where burning had been carried out for many years.

As regards the stocking of the Rupununi the ranchers are of opinion that not more than twenty to thirty cattle should be grazed to the square mile. In this connection it must be remembered that, owing to the changes which occur in the soil and land surface conditions and consequent variation in the nature of the grazing, there are few measured square miles which would actually support twenty or thirty cattle. In the rainy season much of the grazing area is flooded and during such periods the cattle seek refuge on the savannah islands and in the foothills. If the savannahs are to be more heavily stocked it must be remembered that the areas on which cattle may take refuge are limited. Crowding during the rainy weather would ruin grazing or, at any rate, do much harm and losses of young stock would be greater.

(d) Estimated Number of Cattle.

The number of cattle in the northern savannahs is unknown as figures were not available from all the ranchers.

In the southern savannahs the Rupununi Development Company estimate their cattle at approximately forty-six thousand head. In addition to this there are some cattle and pack oxen, owned by Indians, the number of which is unknown.

The number of cattle owned is estimated on the calves branded. The stock originally taken over was estimated by round-ups and cattle counts in the various areas. Each year two round-ups are held and all the calves are branded. Losses are estimated on the number of cattle collected and the reduction in the number of calves branded.

Horses are used by the vacqueros in rounding up the cattle. The Rupununi ponies are on the small side and handy. Being mostly grass-fed they do not possess a great deal of stamina. Each vacquero has three horses for use during each round-up of three weeks. After this the horses are turned loose for two or three months. In some cases Brazilian horses are used, these are larger and stronger.

(e) Diseases.

A discussion of the question of animal disease in the Rupununi cannot, of course, be attempted. The matter is, however, of such importance in connection with any settlement scheme in the district that it must naturally be mentioned in an agricultural report.

The question of tick-borne diseases is worthy of consideration. No actual evidence of such diseases was seen but quantities of ticks were noticed on cattle and in the ears of horses.

During the tour through the savannahs many reports of heavy losses of cattle were obtained from various people. The symptoms described seemed to resemble those attributed to paralytic rabies. Descriptions of the disease were given by Brauno, a farmer at the head of the Moco-Moco creek, by Fathers Mather and Carey of the Roman Catholic Mission, Takutu River, by Mr. E. Melville, the Land Officer of the district, by Mr. Ashburner of the Rupununi Development Company and by Mr. J. Melville, owner of Crystal Springs ranch.

Various estimates of the losses sustained were given. Brauno estimated a forty per cent. loss at Moco-Moco head; Mr. E. Melville estimated a fifty per cent. loss at San Jose while Mr. Ashburner estimated a sixteen per cent. loss in the southern savannahs. The Land Officer accompanied two Brazilian veterinary surgeons on a tour of the southern savannahs during this outbreak of disease. A reprint of their report in a Brazilian journal was seen and it was understood that they diagnosed the disease as paralytic rabies.

Several reports were received of two diseases which are said to have caused, during the last few years, a high mortality among horses.

The disease reported as responsible for the heavier losses is known throughout the savannahs of the Rupununi and Brazil as Mal de Caderas. It apparently causes a paralysis of the hind-quarters preceeding death.

The other disease is not known by any particular name and has apparently only been noticed recently. The horses affected get thinner and thinner and eventually die. It is said that while horses affected by Mal de Caderas always die yet horses attacked by this wasting disease may recover. A horse was seen which had twice been attacked by this disease and had each time recovered. At the time of inspection the animal was strong and in good condition.

The ranchers say that corn-fed horses are never attacked by either disease To feed corn to all horses in the Rupununi is both expensive and impracticable.

The reported losses from these horse diseases were large, so much so that the Rupununi Development Company were seriously inconvenienced during their round-ups. The Company estimates a loss of forty-eight per cent. of their horses during 1933.

Evidence of losses on other ranches was obtained from Father Carey of the Roman Catholic Mission, Mr. Hart at Pirara, Mr. E. Melville, the Land Officer, and Mr. John Melville, owner of Crystal Springs ranch in the northern savannahs.

The question of cattle disease is one of the most important factors in connection with any proposed settlement scheme. The agricultural possibilities of the area are not extensive and owing to transport difficulties the possible sale of any agricultural produce in Georgetown can be ignored.

Revenue production from the farmers' point of view will be derived from the sale of cattle only. If part of his herd is wiped out by disease he will be left in very straightened circumstances, as he will be unable to purchase certain necessities of life such as salt, sugar, flour, clothing and other things. The effect will not be merely temporary, as in the case of a crop lost, he will be left with little or no revenue until he can again build up his herd.

(f) Cattle Products.

Meat. The chief cattle product in the Rupununi is meat. There is little local sale for this product and cattle are killed to supply labourers, ranch employees and the ranch house. Fresh meat is not exposed for sale. All meat is salted and sun-dried and kept in the form of tasso. Tasso is issued three times a day to the labourers, the total weight per day being between one and a half or two pounds. Tasso, together with cassava farine, constitutes the staple food of the people.

Milk. Milk yield is so low that it is of no economic importance apart from a little used in the ranch houses. If there is a large number of milking cattle in the ranch house corrals sufficient is obtained to make a kind of junket known as qualliado. The milk is naturally soured by using a small piece of a cow's stomach as a starter.

Hides. When the cow is killed the hide is usually sun-dried and employed for a variety of purposes such as making sandals, hobbles, raw-hide whips and lariats or it may be cut into strips and used in the place of rope or cord. In some districts the hides are tanned and the leather used for saddlery or shoemaking. Some excellent samples of tanned leather were seen on Mr. John Melville's ranch at Wichabai. The tanning industry in the Rupununi is worthy of investigation with a view to expansion as the leather made is undoubtedly of very fine quality and some excellent leather goods are made. At present the amount utilized is small since the local market for leather goods is restricted. There is in consequence a heavy waste of good material, many hides being thrown away.

Waste Products. It is known that there is a phosphate deficiency throughout the savannah and cattle may often be seen chewing bones. It was suggested to some of the ranchers that, instead of allowing the bones from cattle carcases to rot, they should collect them and grind them into bone meal for feeding the stock. This apparently is not a new suggestion but it has never been tried. Some ranchers in Berbice have experimented with a specially imported bone meal. It is understood that it took a long time and considerable patience to persuade

calves to eat this meal. The question of feeding a local bone meal to *breeding stock* is considered worthy of investigation since they are considerable quantities of bones which can be utilised for the purpose.

(g) The Economics of Cattle Rearing for a Small Family.

After making enquiries throughout the Rupununi District, both from small farmers and ranchers, it is considered that the smallest number of cattle which can maintain a family of five is between a hundred and a hundred and twenty head. This number should allow for a yearly sale of at least thirty steers and for the slaughtering of six to eight per annum for home consumption.

The sale of thirty steers should produce an income of \$250—\$300, and this sum would be sufficient for purchasing necessities such as cloth, flour, sugar, salt, kerosene and coffee. All other requirements would be grown or raised.

(h) Other Stock.

Poultry of all kinds does remarkably well in the Rupununi and is an economic factor in the life of all ranchers. Improvement to the existing breed could be effected by the importation of pure bred stock birds. Some have been successfully introduced.

Pigs do very well in the Rupununi, they breed freely and fatten well, running on the open savannah, in the forest by rivers and in the foothills. The bulk of the pigs are of Brazilian origin and are somewhat of the Berkshire type, short faced, short on the leg and with a deep body. The quality of the pork is excellent. All settlers in the district keep pigs, and though there is little local sale, they supply meat and lard for the homesteads. Pig skin is tanned on one ranch and excellent leather is produced for saddle-making. If easier communication could be established with Georgetown the question of salting pork for local sale would be well worth investigation. There is no evidence of any disease amongst pigs.

Sheep are not extensively reared in the Rupununi. One fairly large flock was seen at Mr. John Melville's ranch at Wichabai. The sheep originally came from Brazil. They are bigger than the average coastland sheep and the mutton is of excellent quality, far superior to any that can be obtained on the coast. They give a good percentage of doubles, and the owner said that they never showed any signs of suffering from disease. The fleece is short, hairy and greasy. Sheep are close grazers and for the most part leave the savannah grasses alone, preferring to graze by the banks of creeks and rivers where there is a fair percentage of short bottom grasses. Sheep-rearing should be of economic value for household consumption to small holders and ranchers alike, as there is plenty of excellent grazing by creeks, rivers and in the foothills.

Very few goats were seen in the Rupununi, and those seen were not particularly good specimens. Little is known by the local people of goat rear-

ing, as only one or two persons have recently started with animals introduced from Brazil. The District generally appears suitable for goat-raising, but the matter requires further investigation, as those seen gave the impression of suffering from intestinal parasites and the young kids did not appear to be very healthy. The goats seen were running in the Government compound at Bon Success. No goats were encountered on the hilly lands.

(j) CULTIVATION.

At the present time there are few signs of cultivation in the Rupununi District and the Pakaraima Mountains. There are, in fact, only limited areas of soil which would profitably support continuous cultivation.

The chief agricultural system of the district is based on shifting cultivation and depends on the utilisation of forested areas. There is no particular method such as a rotation of planting and fallowing, in this system. An area of five to six acres is felled and burnt. A variety of crops are planted, the principal one being cassava. This crop is usually harvested at twelve months and the farm is then abandoned. A fresh area is cleared for planting and although produce may still be obtained from the old farm, it is not cultivated. No area was seen where an attempt had been made to renew cultivation after a number of years. In the savannahs the bush islands are used for shifting cultivation; in other areas forest lands are utilised.

There are several reasons why shifting cultivation is the general system of agriculture. The majority of the land is not sufficiently fertile to produce more than one satisfactory crop. Rotational planting is not understood by the farmers of the district. The agriculture is of the "lazy man" type for as soon as the crops are established no weeding, forking or hoeing is done. After about twelve months the farms are smothered with weeds and secondary growth. It is far easier to fell and burn another area of virgin bush than to clear the secondary growth. There are few cultivators in the district and fairly extensive tracts of forested land are still available. There is therefore no necessity to establish a permanent farm. The practice of shifting cultivation is so ingrained that even on the good soils which would support continuous cropping the farms are moved. Many of the settlers go to considerable trouble to establish farms in forested areas where protection from cattle is simple. Mr. E. Melville's cultivation is about seven miles from his homestead, while the farm of Mr. J. Melville's, is about fifteen miles from his residence.

Certain ranchers obtain fair crops of cassava by planting in cattle corrals which have received additions of animal manure. The practice pre-supposes the possession of stock and the availability of fencing material. Some settlers have surrounded their houses by fenced compounds and in these areas, which are manured by pigs and poultry, vegetables and fruit trees do well, especially when irrigation water, obtained by means of windmill pumps, is available.

Cassava is the principal crop grown in the district and in form of farine is the chief staple of diet. It is supplemented by other root crops such as yams and sweet potatoes. Sugar cane is used for chewing purposes, for the preparation of a fermented drink and for the production of open-tayche sugar. Maize is usually eaten green. It also has considerable importance as a stock feed in the Rupununi. Bananas and plantains augment the food supply. Peppers grow well and are much used by the Indians. Cotton is grown for the purpose of making hammocks but the cultivation is decreasing. In former times hammocks were used for barter, but since the development of the cattle industry and balata bleeding fewer hammocks are made. Pawpaws are used as a fruit or vegetable. Very little padi is grown at present but there is scope for its development. A few farmers are planting Brazilian coffee for home consumption. Very little guinea corn is grown and the area under this crop might with advantage be increased. Castor oil plants are cultivated for medicinal purposes. In Brazil the oil is used as an illuminant. Tobacco is grown for home consumption and also in increasing amounts for export to Georgetown. The transport of small samples is comparatively easy and the farmer is able to derive a certain revenue from its sale. The industry in Brazil is of great importance, but there is a very large internal market for such tobacco in that country.

There are very few small farmers, other than Indians, in the Rupununi. Most of their foodstuffs are grown and with the proceeds from the sale of cattle and crops certain necessities of life are purchased. Farine is the most important food and one person consumes on the average one and a half pounds a day. Tasso or dried meat is the next most important food and from one to two pounds per head per day are consumed when available. Other kinds of meat such as pork, mutton, poultry and deer are used. One steer will give about three hundred pounds of salted meat and it is usual to divide a carcase between two or more families. A number of commodities such as coffee, tea, salt, sugar (supplemented with syrup from home grown cane) matches, soap or caustic soda, cloth, powder and shot have to be purchased. It is difficult to estimate the value of the foodstuffs grown and the goods purchased, but it is likely that the average peasant farmer handles in cash about $6.00 a month and that this is sufficient to make the necessary purchases for a family of four.

The Indians live a simple life and have few requirements. Those who suffer the proximity of civilisation are educated to the use of clothes and scarcely cultivate any land. In some areas, such as Annai and the surroundings, cultivation has ceased. The Indians either find employment on cattle ranches or make, for themselves, a fairly remunerative living as balata bleeders. They rear a few cattle, mostly pack oxen. It is to be regretted that these Indians have given up their cultivations for when employment is scarce or balata prices are low a considerable amount of hardship is experienced.

The Indians further removed from civilisation are entirely self-supporting. They bleed balata when the price is favourable but they never neglect their farms.

(k) Possibilities of Future Settlement.

The possibilities of future settlement in the district will depend largely upon the characteristics of the proposed settlers. If they resemble the Indians and have few requirements, then a considerable number might be cautiously introduced. If on the other hand they are of the small farmer type, their standard of living will be higher and fewer families should be introduced with great care.

With the present transport facilities there is no likelihood of an export trade of crops to Georgetown and cultivation will be confined to the production of foodstuffs for home consumption. There may be a small internal market supplying the wants of the bigger ranchers or balata bleeders.

There are few areas of good agricultural soil where continuous cultivation may be practised and the majority of these areas are either within Indian Reservations or have been occupied by Indians for some considerable period. If farming is to be undertaken in bush islands and forest areas on the system of shifting cultivation then a considerable amount of investigational work is required to determine the amount of produce an area will yield before fertility is exhausted, the period of resting required to restore fertility and the effect of cultivation upon yields in order to form an estimate of the area required to support a farmer and his family. Some estimate of the forest country available would also be required. Cultivation in corrals pre-supposes the possession of cattle and the distribution of suitable livestock to settlers is likely to take some time.

A small farmer in the district needs a certain amount of cash in order to purchase necessities and his only source of revenue is likely to be from cattle rearing. At the present time this occupation appears to be unremunerative and the more prosperous ranchers usually engaged in other occupations to supplement their incomes.

An experiment farm should be established in the district where experiments on breeding improved types of beef cattle for sale in Georgetown, and possibly for export, could be conducted. Trials with pigs, sheep, goats and poultry should be made, for they are likely to be economic factors in the life of a settled people. Useful work could be done with improved varieties of the crops already grown in the district and with others that might be introduced. Special attention should be paid to padi, guinea corn, beans, peas, and ground nuts. There is a lack of vegetable oil in the present diet. Oil might be obtained from the Awarra palm.

The development of the district depends upon the livestock industry and it is therefore essential that the question of animal disease should be fully investigated.

There is at present a lack of information regarding the agricultural and economic lives of the proposed settlers, but it seems likely that the Pakaraima Mountains offer better possibilities of settlement. The area is elevated and well-watered. There are extensive savannahs and the cattle seen were in good condition. There is at least one fairly extensive area of good soil. The district, regarded as a settlement area, has one or two disadvantages. The route traversed on this tour from Kurasabi to Santa Maria is mountainous and in large stretches of forest little grazing is offered. It is possible that stock would reach the trail in fair condition if driven carefully and might be rested before making a further stage. The route is certainly no worse than the cattle trail between Kurupukari and Canister Falls. It is possible that an alternative trail might be found and this point is worthy of further investigation. Kaboura fly is prevalent in the valleys of the Ireng and the Echilibar Rivers but was not encountered in the fertile areas of the Yawong valley.

Home Crafts. The development of home crafts in the Rupununi might lead to a small revenue producing trade.

The tanning, preparation of skins and leather work generally has been brought to a high pitch of perfection on Mr. John Melville's ranch at Wichabai. Some excellent tanned hides of many kinds were seen, and the sale of these in Georgetown could be developed, if transport conditions improve. Excellent shoes and sandals are made on the premises from cow hide, horse hide and deer skin. The class of workmanship is very good and the leather of excellent quality and good wearing properties. All kinds of saddlery and harness are made. It is thought that the work could be further developed together with the production of fancy leather goods. At present the leather trade is confined entirely to the Rupununi District and Brazilian border.

Weaving. Excellent cotton hammocks are made in the district, particularly by the Wapisiana Indians. The cotton is grown locally and spins into a strong thread. Weaving might be developed and it is thought that a heavy cotton cloth similar to that woven in West Africa could be made. Cotton grows well in the Rupununi and is free from pests and diseases, and its cultivation could be extended if the weaving industry developed.

Pottery. There is a small trade in the district at present in the manufacture and sale of earthenware pots, water coolers, and other articles.

Brick-making is already established on a small scale and excellent sun-dried bricks for house building and flooring were seen. If the district is to be settled, use can be made of this industry for furnishing building materials.

(8) SUMMARY.

Few signs of cultivation are seen in the Rupununi District and the Pakaraima Mountains. At present farming is conducted under the system of shifting cultivation in forested areas. There are a few limited areas of good agricultural soil which would support continuous cultivation, but even on these areas the farmer does no weeding or forking and finds it simpler to clear a fresh

area of virgin bush rather than to keep his original cultivation clean. The soils of the open savannah are poor and do not produce economic yields unless dressed with manure. The practice of planting in disused corrals pre-supposes the possession of stock and the availability of fencing material in an area where timber is scarce. Certain areas in the open savannahs might support swamp rice if the creeks are used as a source of irrigation water. Such cultivation would require adequate protection from cattle. Areas of good soil are usually found in the foot-hills and valleys of mountain slopes of northern or north-western aspect. Such areas are to be found in the Kanuku Mountains, the Kusad Mountains, the Shiriri Mountains, the mountains of the Kurasabi Reserve and possibly the Annai hills. What promises to be a fairly extensive area of exceptionally fertile soil was encountered in the broad valley of the Yawong River between Wandapatoi and Paramakatoi. Time did not permit of making more than a rough estimate of the extent of the good soils. More detailed surveys are necessary in this connection.

If the proposed settlers are, like the Indians, simple people with few requirements, then a considerable number might be cautiously introduced. If, on the other hand, the settlers are of the small farmer type, then they will have to be in a position to purchase certain necessities. Under present transport conditions cultivation is likely to be for home consumption alone. The only source of revenue for settlers is stock rearing. Settlers will not be entirely self-supporting until they are in possession of cattle that can find a remunerative market. Such arrangements will take time. If the less fertile forest-covered soils are to be utilised under a system of shifting cultivation, then it is essential that field experiments be executed in regard to the amount of produce obtained from a given area before fertility is exhausted, the period of resting required to restore fertility and the effect of cultivation upon yields. . Improved varieties of the crops already grown should be introduced and the possibilities of new crops investigated.

Any form of permanent settlement must at present be based on stock-farming. It is therefore of the greatest importance that the question of animal diseases should receive attention.

The Pakaraima Mountains seem to present the more promising possibilities for settlement. There might be some difficulty in moving cattle from the area but means of transport should receive attention.

It is a great pleasure to acknowledge the very considerable assistance rendered by E. A. Haynes, Esq., Commissioner of the Rupununi District. Mr. Haynes accompanied the party through the Pakaraima Mountains at considerable personal inconvenience. Without his presence it would have been impossible to obtain porters and to have seen the more interesting portions of the area.

Thanks are also due to Messrs. J. Melville, A. Ashburner, E. M. McTurk, E. Melville, T. Orella and B. L. Hart for their hospitality and for much interesting information regarding the District.

REPORTS.

FOURTH MEETING OF THE ADVISORY BOARD OF AGRICULTURE, NOVEMBER 20, 1935.

PRESENT.

Director of Agriculture	... ...	*Chairman*
Deputy Director of Agriculture	... ...	*Vice-Chairman*
Hon. F. J. Seaford Mr. R. E. Brassington Mr. W. H. Richards Mr R. B. Hunter	... ...	*Members*

with

Mr. J. F. Irving, M.C.	... ...	*Secretary*

ABSENT.

Mr. S. Andries Hon. Peer Bacchus	... ...	*Members*

The Minutes of the last meeting which were previously circulated were confirmed.

The Chairman reported that the Plant Pests and Diseases Ordinance which had been approved by the Board had been passed by the Legislative Council on November 19.

The Secretary read all the correspondence and reports relative to the trial shipment of bananas made by the s.s. "*Ingoma*" in August.

Mr. Brassington asked where most of the bananas shipped had come from and was informed that the bulk had come from West Coast and West Bank, Demerara ; a few bunches only from Pln. Hope, East Coast, Demerara.

Mr. Hunter stated that he observed that some of the bunches were reported to have arrived in a diseased condition and asked for an explanation as to this disease. The Chairman replied that the disease in question was one of the fruit caused by fungal organisms ; normally, such disease would not show up on the growing plant. There were several rots which affected bananas after reaping depending on variety and conditions of storage.

In reply to a question by Mr. Brassington as to reports on the conditions of trial shipments made from the Gold Coast, the Deputy Director read some interesting extracts from the "Gold Coast Farmer" in conneetion with experimental shipments of Cavendish bananas made therefrom. It was observed that the results in many cases had shown a loss due to fluctuations in price.

After full discussion Mr. Seaford proposed, and it was agreed, that further trial shipments of bananas from this Colony to the United Kingdom should only be made if satisfactory arrangements for the carriage of the fruit on board ship were available. Messrs. Harrison's should be written to and asked what improvements they were prepared to make in this connection. It was also agreed to enquire from Messrs. Booker Bros., McConnell & Co., Ltd., whether they would be prepared to consider the fitting out of one or two of their steamer holds for the carriage of bananas.

The Board decided to postpone consideration of the proposal to put down a 10-acre experimental block of bananas under optimum conditions until such time as shipping arrangements improved.

Finally, it was the unanimous wish of the Board that all reports on the trial shipment, including the summary minute by the Director of Agriculture, should be made public at the same time as they were communicated to the Banana Association, the Chairman to obtain the approval of His Excellency the Governor in this connection.

The Chairman stated that he would like to mention that a small shipment of Buxton Spice mangoes had recently been made to Canada. He was still awaiting a further report from the agents but there was no doubt that the Canadian market preferred mangoes of the "Julie" or "Bombay" types rather than the "Buxton Spice," a recognised local variety.

The Chairman also reported that he had forwarded to the West India Committee a small shipment of green limes as he thought that there was a possibility that a demand for these might arise if the lemon output from Italy was affected by the war.

The Chairman informed the Board that the question of a ghee plant in Essequibo was engaging the attention of Government as well as the importation of beef bulls to be stationed in that area with the object of improving the beef production. Also, that future livestock policy generally would include more attention to beef now that the dairy improvement work was well in hand.

The Chairman said that he had been approached by several interested persons with a view to the resuscitation of the local Poultry Association to be run on lines

similar to the Beekeepers' Association which had proved so successful, and which had done such excellent work for beekeepers. It may be noted that the old Poultry Association was not run under the auspices of the Department of Agriculture although the Department had co-operated with it.

In connection with the Animals (Breed and Contagious Diseases) Bill, the Chairman stated that it was doubtful whether it would be possible to deal with this legislation during the present session of the Legislative Council. As he had previously informed the Board, the matter was discussed with those interested in livestock in Berbice, but so far, he had not received very much assistance from them. He considered that the Bill could be held over now until the Livestock and Meat Products Committee which His Excellency the Governor was appointing had forwarded their report to Government. The Bill, while providing much-needed legislation, contained one or two clauses which might be difficult to enforce at present.

The Chairman mentioned that he had been in consultation with the Director of Education in connection with a "scheme for the introduction of a syllabus for elementary rural science and gardening in the schools." As the Department of Agriculture had for some years been emphasising the need for training the teachers in such work, in the first place, it was now decided to accept that view and that an intensive course of agricultural training to last six months should be given to twelve selected teachers by way of trial. The courses would probably start early next year.

The Chairman stated that very great interest was being taken at present in insecticidal plants particularly by American firms. The Chemist, Mr. R. R. Follett-Smith, while on leave in England, had been in touch with the authorities at Rothamsted and hoped to be in a position to carry out experiments to discover the optimum stage of growth at which local Haiaris should be cut for their maximum content of the poisonous principle (rotenone). It will be remembered that a substantial area was under experimental cultivation in the North West District and recently some of the plants had flowered for the first time thus enabling identification to be established, which was of fundamental importance in extending cultivations, should this be justified in the light of results obtained. As the root was the most valuable part, it was essential to prevent promiscuous collection and destruction of these plants before their value was fully ascertained, since any chance of developing a minor industry would be seriously prejudiced thereby.

The Chairman informed the Board that the appointment of Mr. A. A. Abraham, Assistant Agricultural Superintendent, as an Agricultural Superintendent *vice* Mr. A. deK. Frampton, transferred, had been approved by the Secretary of State for the Colonies.

This being all the business, the meeting terminated.

HONEY WEEK.

The Department of Agriculture and the British Guiana Beekeepers' Association collaborated in a honey advertising effort and declared October 28 to November 2—"HONEY WEEK".

For some time prior to this date, honey was given much publicity by frequently appearing articles in the local press on bees and the value of honey. This publicity campaign was especially effective on account of a newspaper controversy, which attracted considerable attention to the food value of honey.

The chief feature of "Honey Week" was an attractively prepared show window at Messrs. Bookers Amalgamated Groceries, Ltd., Water Street, exhibiting honey collected from every district in the Colony. The exhibit consisted in the main of three pyramid-like forms. The two forms on the outside were intended to represent two halves of a skep (or ancient hive), while the central form was somewhat different in shape and was built in a characteristic tier-like arrangement. In the middle of the central form there was a revolving electric sign, which informed the passer-by that "HONEY GIVES NATURAL ENERGY", "EVERY DROP DOES YOU GOOD", "ATTRACTIVE HONEY IN ATTRACTIVE JARS AT ATTRACTIVE PRICES", "EQUALLY GOOD FOR YOUNG OR OLD, ATHLETES OR INVALIDS". On the shelves, jars of honey, all contributed on loan by members of the British Guiana Beekeepers' Association were placed, and in the background, lights diffusing through the honey were calculated to show the honey to best advantage. The honey on exhibition ranged from the darker Georgetown honey (very much in the minority) through the lighter shades to the very clear logwood honey. In the foreground were solid cones of wax, section honey, glass hive, honeycomb and a large scale drawing of the three different types of bees. The show window was best seen to advantage at evening time.

The honey collected from different parts of the Colony, arranged and presented in a display to the public, was intended to demonstrate the uniformly good quality of local honey, the standardised containers and labels in general use and the availability of honey in sufficient quantities to meet all demands.

The Association owes a special debt of gratitude to Messrs. Bookers Amalgamated Groceries, Ltd., for their courtesy in lending their window; to Mr. L. B. Philpot of the Demerara Electric Co., for his personal interest in the lighting, the arrangement of the electrical signs, etc.; and to various members of the Association

for valuable assistance in this, the second honey advertising project within the year. The week's activities were suitably brought to a close by a broadcast talk given by the Director of Agriculture over Station VP3MR.

From accounts received from various beekeepers, it appears that this advertising project has provided a decided fillip to local honey sales. The following extracts of letters received from beekeepers in different parts of the Colony indicates the general attitude towards the work at present being undertaken in connection with the beekeeping industry :—

> "I expected a fair response to Honey Week, but the amount of effective "publicity we are getting astonishes me; and I think the Association "should feel very bucked about it."

> "I hope the Association may long live and that beekeepers may try their "utmost to make it an industrial concern."

> "Beekeepers ought indeed to feel enormously indebted to the executive "of the Association for the persistent efficient efforts that are being "made to secure a market for local honey and in so doing to make bee-"keeping a payable hobby."

LEGISLATION.

RICE EXPORT REGULATIONS.

The Rice (Export Trade) Regulations, 1935, came into force on August 29 last. The chief features of these Regulations are :—

(1) an exporter may extend credit to a buyer for not more than 30 days ;

(2) an additional cost of 10 cents to the price per bag fixed by the Board is to be added for these credit facilities ;

(3) the remuneration from an exporter to his agent may not exceed 10 cents per bag ;

(4) bank charges may be paid either by the buyer or seller ;

(5) export prices are to be fixed by the Board but when such prices are not fixed by the Board prices agreed upon between exporter and buyer must be approved by the Board ;

(6) rebates are prohibited ;

(7) each contract, of a form specified, must be produced to the Secretary of the Board ;

(8) orders must be registered with the Secretary of the Board ;

(9) orders to which any price is affixed, may be registered either at or above the price at the date of registration or at the Marketing Board's price at date of shipment ;

(10) the Board must be informed whether each contract has been effected directly with the buyer or through an agent ;

(11) the buyer may investigate the *bona fides* of a sale ;

(12) rules are laid down for the procedure to be followed in the event of an increase of price before registration and variation of price after registration ;

(13) an exporter must register his agent or agents outside of the Colony ;

(14) on each bag for export the grade must be printed.

PESTS AND DISEASES REGULATIONS.

The Plant Diseases and Pests (Prevention) Ordinance, 1920, has recently been revised and brought up to date in accordance with recommendations made at recent Imperial Entomological and Mycological Conferences.

NOTES.

Grapefruit Investigations in Trinidad.—A very interesting report by F. Hardy and G. Rodriguez appears in *Tropical Agriculture* XII No. 8, pp. 205-215 and consists of a summary of results obtained during the sixteen-month chemical investigation of typical grapefruit soils in Trinidad considered in relation to the requirements and effects of manurial treatments, as gauged by the composition of grapefruit leaves. In addition it presents preliminary data on the composition and quality of grapefruits, in comparison with fruits grown in other countries.

The report describes the specific requirements of the grapefruit and indicates the special importance of soil calcium in grapefruit growing.

The first part of the report is concerned with the chemical examination of soil samples collected from representative grapefruit fields. The general conclusions reached are that the grapefruit soils of Trinidad are characterised by an apparently unsatisfactory lime status, very low available phosphate contents, usually inadequate available potash contents and very high total nitrogen contents. Probably the most important suggestion derived from this branch of the investigations is that the correction of lime deficiencies in acidic grapefruit soils may be responsible for a saving in potash manure required for the greatest production in yield of fruit of high quality. That the lime and potash contents of grapefruit leaves bear a very high degree of negative correlation suggests that an increase in leaf lime content (which investigations have shown to be induced by soil liming) may suppress the excessive uptake of potash and its passage into the leaf. This may mean that the supply of potash in the soil need not be so abundant when adequate lime is available to the growing plant. It is tentatively suggested that the standard lime status in Trinidad grapefruit soils should consist of a 65 per cent. saturation with regard to lime.

The second part of the report describes the results of the chemical examination of grapefruit leaves. Leaf material from a large manurial trial on limed soil was analysed. The results indicate that certain mixtures of potash and nitrogen were preferable. These conclusions were identical with those formed from an examination of the growth rates. The examination of leaves collected from typical manured grapefruit fields in Trinidad indicated general sufficiency or excess of nitrogen and potash, but a marked deficiency of calcium and phosphate, suggesting the need for lime, and caution particularly in the use of nitrogenous manures.

The third part of the report deals with the results of chemical analysis of typical grapefruit. Trinidad grapefruit contains a relatively high proportion of

juice and pulp and a very high sugar-acid ratio as compared with certain published analyse of fruit grown in Florida, Puerto Rico and Texas. Its quality thus appears to be good.

The results suggest that grapefruit from trees growing on lime-land are of better quality than that obtained from trees growing on acidic land.

The general supposition arising from these three lines of investigation is that grapefruit trees, and citric trees in general, are lime-loving plants and thrive best in soils containing relatively abundant supplies of available lime.

The next obvious step in these investigations, if it has not already been taken, is the establishment of well-designed liming trials on several grapefruit estates. No doubt those grapefruit growers who consider themselves progressive agriculturists will have already made experimental applications of lime to a few of their trees.

R. R. F. S.

Haiaris.—Considerable interest in the insecticidal possibilities of the Haiaris has been evinced in several quarters recently, and many enquiries have been received by the Department concerning them.

The White Haiari in cultivation at Wauna Sub-station produced flowers on a few plants in April, this being the first time that this plant has been found flowering in the Colony. The flowers, which are blue, and fruits were sent to Kew, and there identified as *Lonchocarpus Nicou* (Aubl.) DC.; the plant is therefore conspecific with the cubé of Peru. It remains, however, to be seen whether the local species contains such a high percentage of toxic matter as the Peruvian plant.

Flowers of the Black Haiari which is regarded as being the most potent of the local types, are still to be obtained.

E. B. M.

Pink Lotus Lilies.—The history of the Lotus lilies of the Botanic Gardens, so sought after as decorative flowers, presents one or two rather interesting features.

The true red, or pink lotus, *Nelumbium speciosum* Willd. (= *N. nucifera* Gaertn.) was introduced into the lakes in 1882, shortly after the establishment of the Gardens, and grew there profusely. It is a deeper shade than the Lotus lilies to be seen in the Gardens to-day, but may be seen in trenches in various parts of the Colony.

In 1885, it was decided to introduce the yellow American Lotus lily, *N. luteum* Willd. and seed was obtained from Florida. The plant grew readily in the lakes, but after 10 years, had never flowered. This was apparently due to its originating from a strain acclimatized to the sub-tropical climate of Florida, and not suited to local conditions. A fresh introduction therefore was made from Jamaica (in 1895) and the plants of this stock flowered well. A few years later, however, it was noticed that *N. luteum* and *N. speciosum* had crossed, giving rise to a variety of intermediate shades, all paler than the original parents.

In 1901 it was recorded that the original deep pink of the Lotus lilies was giving place to a paler colour, and in 1903 there were no pure plants of *N. speciosum* left, and only a few of *N. luteum*. Subsequently, these too, have been lost and only the pale pink hybrid remains in the Gardens to-day.

It is intended now to re-establish the two separate species in different parts of the Gardens. These are the only two species of *Nelumbium*. *N. luteum* is a native of the southern part of North America ; *N. speciosum* is indigenous to the Eastern hemisphere and is the sacred Lotus of the East.

It is recorded that seed was obtained from Kew in 1885 of a number of so-called varieties of *N. speciosum* from Japan, but when the plants grew and flowered they all turned out similar to the true pink Lotus.

E. B. M.

The Rothamsted 1934 Report.—The Rothamsted Experimental Station is our leading Institute for the study of soil science, plant nutrition, and plant disease. Its activities cover a wide field. There are the well-known experiments on the parent farms at Rothamsted and Woburn, amplified by similar trials at a number of outside centres. In addition the laboratory workers are applying the methods of chemistry, physics and biology to the many problems arising in crop production and utilisation. The appearance of the Annual Report for 1934 enables all interested in the land to obtain a clear view of the recent activities of the Station. Progressive farmers and their technical advisors will turn to the sections summarising the results of recent fertiliser investigations and continue with the detailed account of the field experiments of 1934. The scientific specialists, to whom the report needs no recommendation, will find a welcome feature in a series of review articles on the contribution of certain of the Departments to their respective branches of soil science. Dr. Keen writes on soil physics, Dr. Crowther on chemistry of soils and fertilisers, Dr. Thornton on soil bacteriology, and Mr. Cutler on general biology. From a publication so full of information as the present report, it is possible in a brief notice to mention only a few sections of immediate practical importance.

Sugar beet growers will find much of interest in the results of the extensive fertiliser tests carried out in conjunction with the factories: nitrogenous manures were the most important in improving sugar per acre in 1934. Accurate information on the effects of organic manures, and in particular of dried poultry manure, is now beginning to accumulate. Neither in 1933 nor in 1934 was the activity of the nitrogen of dried poultry manure as great as that of sulphate of ammonia. Recent work on basic slags tends to show that their solubilities as measured by the old citric acid test is a good guide to their agricultural availability. Work on the maintenance of organic matter by ploughing in straw, or manures made from straw, or green manures, still continues. This side of the work in conjunction with the continuous cereal plots testing the effects of bare fallowing, is of special bearing on soil fertility under mechanised cereal farming.

In addition to fertiliser tests, problems in general husbandry are being studied. For example, the preliminary results of comparisons of electric motors with oil engines for threshing are on record.

For the many field workers at home and overseas who are adopting the methods field experimentation elaborated at Rothamsted, the report provides many examples of modern designs. There is also a useful statistical note on the construction and use of the summary tables relating to the field experiments. This section gives precision to such terms as "interaction of fertilisers" and indicates the correct use of standard errors.

The report contains a useful summary of the Rothamsted work on virus diseases. Virus is almost certainly particulate and different viruses are of different sizes. The particular virus examined is not an invisible stage of a visible bacterium, but virus is probably a form of living material. It has further been found that the inoculation of a plant with one strain of virus may protect it against a later inoculation with another more virulent strain of the same virus. The part played by insects in the transmission of these diseases is discussed in the light of recent experiments.

NEWS.

Dr. V. C. Dunlap of the United Fruit Company paid a return visit to the Colony from August 10 to September 1. He paid visits to Mr. L. DeVeaux's banana cultivation at Pln. Dunoon, Demerara River, and inspected other banana-growing areas. He reiterated the opinion that extension of Gros Michel plantings should proceed only with the greatest caution.

His Excellency the Governor visited the Department's Experiment Station, Botanic Gardens, on September 6.

The Director of Agriculture visited Berbice on a tour of inspection from September 9 to 13.

A Farmers' Field Day was held on September 23. A representative group of farmers attended. Among the special items of interest were the variety and manurial work at the Sugar and Rice Experiment Stations; trials at the Livestock Farm with poultry, pigs, Holstein-Friesian and Guernsey stud animals, etc. In the orchard crop nurseries, propagation methods proved especially interesting The Director of Agriculture welcomed the farmers in the morning and officers were in attendance throughout the day to make demonstrations in connection with, and to discuss, any phase of the work in progress.

The Secretary of State for the Colonies has been pleased to appoint Mr. A. A. Abraham, formerly Assistant Agricultural Superintendent, to be Agricultural Superintendent *vice* Mr. A. deK. Frampton, transferred on promotion to the Straits Settlements.

Mr. F. Burnett, Deputy Director of Agriculture, returned from leave on October 7, The caskets presented by this Colony to their Majesties on the celebration of their Silver Jubilee were entrusted to the personal care of Mr. Burnett and were delivered immediately on his arrival to the Colonial Office.

During his holiday in England, Mr. Burnett attended an Agricultural Conference at the Rothamsted Experimental Station, visited Jealott's Hill, the Agricultural Research Station of the Imperial Chemical Industries, Ltd., and Seale-Hayne Agricultural College, Devonshire. He also visited the Colonial Office in connection with the manufacture of Ghee and while *en route* from England, visited the Agricultural Experiment Station and Botanic Gardens, Surinam. Many problems were discussed with Professor Stahel, from whom was obtained some selected seed of high-yielding padis.

The Government Botanist visited the North West District from October 30 to November 14 to inspect the Experiment Station at Hosororo and the Sub-station at Wauna. Whilst in the District he accompanied the Commissioner to Arakaka and inspected the tobacco cultivation there.

Mr. R. R. Follett-Smith, Chemist, returned to the Colony from leave on November 7. A stay of ten days in Barbados provided many opportunities of discussing with the officers of the Barbados Department problems connected with soil investigations and cane variety breeding and testing.

In England visits were paid to Rothamsted Experiment Station where methods for the evaluation of the toxic properties of local fish poisons were discussed, to Jealott's Hill, the Agricultural Research Station of the Imperial Chemical Industries, Ltd., where the fertiliser requirements of the Colony's crops were discussed and to a sugar refinery of Messrs. Tate and Lyle.

During the month of August the Chemist represented the Colony at the Third International Society of Soil Science held at Oxford. The Post Congress tour included visits to Harper Adams Agricultural College; University College at Bangor; the Macaulay Institute for Soil Research; the Craibstone Experimental Farm and the Rowett Research Institute of Animal Nutrition at Aberdeen; the Macaulay Demonstration Farm on the Island of Lewis; the Armstrong College, Newcastle; the fertiliser factory of the Imperial Chemical Industries, Ltd. at Billingham and the Cambridge University Farm.

The Chemist spent the month of October at the Imperial College of Tropical Agriculture, Trinidad, and visited the packing shed of the Trinidad and Tobago Citrus Growers' Association to investigate the methods of colouring, cleaning, grading and packing of fresh fruit, the canning of grapefruit and juice preservation. Several grapefruit, sugar and coconut cultivations were visited together with members of the College staff. This stay in Trinidad permitted the discussion of many problems with the staff of the Chemistry Department of the College.

The following members of the Department obtained short leave :—

Mr. H. Macluskie, Agricultural Superintendent, from August 1 to 14, 1935; Miss M. Cheong, Clerk, from August 28 to September 10, 1935; Mr. J. F. Irving, Chief Clerk, from August 24 to September 27, 1935; Mr. H. E. H. Gadd, Rice Grading Inspector, from October 12 to 18; in addition, Mr. Gadd was granted six weeks' leave of absence to visit Jamaica on behalf of the Rice Marketing Board. He left the Colony on November 6 by Pan-American Air Mail; Mr. C. C. Dowding, Agricultural Instructor, from October 14 to November 9; Mr. F. A. Squire, Supernumerary Entomologist, from October 28 to November 8; Mr. E. M. Peterkin, Agricultural Superintendent, from November 10 to December 9.

Mr. A. A. Thorne, Accountant, resumed duty on October 16, 1935.

PLANT AND SEED IMPORTATION.

Introductions by the Department of Agriculture for the period ending December, 1935.

NAME	QUANTITY	WHENCE SUPPLIED
Economic.		
Achras sapota	1 packet seed	U.S. Department of Agric.
Aleurites montana—Tung Oil	11 seeds	Coconut Grove Arboretum, Florida, U.S.A.
Algaroba or *Kiawe*	1 box seeds	Hawaiian Expt. Station, Honolulu, Hawaii.
Erythroxylon coca	1 packet seed	U.S Department of Agric.
Cinnamon	2 lb. „	Royal Botanic Gardens, Ceylon.
Mango—'Gordon'	2 plants	Dept. of Agric., Dominica, B.W.I.
Onion—red & white	30 lb seed	Messrs. Hamilton & Co., Teneriffe.
do. Crystal White Wax, Yellow Bermuda, Varela's Purple	1 oz. seed each	Federico Carlos Varela, Teneriffe.
Orange—'Navel'	50 buds	St. Augustine Nursery,
Grape Fruit—'Pink Marsh'	24 buds	Trinidad, B.W.I.
Passion Vine	2 fruits	Imp. College of Tropical Agriculture, Trinidad.
Asstd. Vegetables	30 packets seed	Vilmorin-Andrieux, France.
do.	3 lb. 9 oz. „	Messrs. Peter Henderson, U.S A.
do.	12½ oz. „	Messrs. Sutton & Sons, England.
Ornamental.		
Acrocomia crispa Cuba	6 seeds	
Martinezia erosa Linden	39 „	
„ *Lindeniana Wendl.*	19 „	David Barry, Los Angeles, U.S.A.
Erythea elegans Franceschi	9 „	
Jubaea spectabilis	1 box seed	
Arecastrum romanzoffianum	1 packet seed	U.S. Department of Agric.
Phoenix dactylifera	1 tin seed	Coconut Grove Palmetum,
Washingtonia robusta	do.	Florida, U.S.A.
Lilium longiflorum var. *eximium*—Bermuda lily	1 doz. bulbs	Dept. of Agric. Bermuda.
Hippeastrum sp.	do.	
Acacia scorpioides	1 packet seed	U.S. Department of Agric.
Asparagus sprengeri	do.	
Barleria—white & pink	60 cuttings	Dept. of Agric., Trinidad, B.W.I.
Chamaedorea concolor	1 packet seed	U.S. Department of Agric.
Clitória ternatea alba	2 packets „	
Iris spp.	3 packets „	Eugene M. Verges, U.S.A.
Sabinea carinalis—Carib Wood	1 packet „	Dept. of Agric., Dominica, B.W.I.
Ficus aurea	1 packet „	U.S. Department of Agric.
„ *nitida*	4 cuttings	Dept. of Agric., Barbados, B.W.I.
Asst. Flower Garden seeds	26 packets	Sutton & Sons, England.
Do.	50 packets	Vilmorin-Andrieux, France.

CURRENT PRICES OF COLONIAL PRODUCE.

From The Commercial Review, Journal of the Georgetown Chamber of Commerce, Vol. XVIII, No. 16, October, 1935.

SUGAR.

Per 100 lbs. net   3 lbs. per Bag allowed for tare

Dark Crystals for Local Consumption..........$3.30
Yellow Crystals do. do. $4.00
White Crystals..........$4.75
Molasses Sugar..........none offering.

Above Prices include Excise Tax $75.

RUM.

Imperial Gallon.   Cask included.

Coloured, in Puncheons—40 to 42 O.P...(for export)...60c.; Hhds. 52c., Barrels 77c.
White, in Hogsheads—10 to 45 O.P...(for local consumption)..........45 to 55c.

MOLASSES.

Per Imperial Gallon.   Naked.

Yellow (firsts)..........10c.
Yellow (seconds)..........5½c.

RICE.

Rice..........per Bag of 180 lbs. gross, Brown Super $3.60 to $3.75 ; No. 1, $3.50—$3.60 ; White $3.00. Lower Grades $2.25—$2.50 as to quality.
Paddy..........per Bag of 143 lbs. gross, 80c. to $1.20

GENERAL.

Timber, Greenheart, (Lower grade measurements)...40c. to 60c. per c. ft.; for export 72c. to $1.00 per c. ft.
do. Railroad Sleepers—(Mora)..........$1.68 each
Greenheart Lumber..........$60 to $70 per 1,000 feet.
Crabwood Lumber..........$60 to $75 per 1,000 feet.
Shingles, Wallaba, 4 x 20 and 5 x 22 inches,..........$3.50 to $5.50 per M.
Charcoal, Capped for shipment..........72c. to 85c. per bag.
Firewood..........$2.16 to $2.50 per ton.
Coconuts...Selects, $9.00, culls...$6.00 M...Copra $2.00 per 100 lbs.—Prime Copra.
Balata..........Venezuelan, none. Local Sheet...36c. to 38c. per lb.
Cocoa..........19c. to 19½c. „ „
Coffee..........4¾c. to 5c. „ „

N.B.—Duty on Payable value at time of Importation and rate of exchange on day of arrival.

METEOROLOGIAL DATA—JULY TO SEPTEMBER, 1935.

Recording Stations & Months.	Rain-fall.	NUMBER OF DAYS OF RAIN						Evaporation	Air Temperature			Humidity.
	Total Inches.	Under ·10 Inch	·10 to ·50 Inch	·50 to 1·00 Inch	1·00 Inch to 2·00 Inches	Above 2·00 Inches	Total days.	Inches	Maximum.	Minimum.	Mean.	Mean.
Botanic Gardens.												
July ...	8·12	9	7	5	2	...	23	4·51	85·2	75·5	80·3	83·3
August ...	13·78	6	8	...	5	1	20	4·51	85·7	75·3	80·5	83·4
September ...	5·39	2	4	2	...	1	9	5·93	86·8	76·5	81·6	78·9
Totals	27·29	17	19	7	7	2	52	14·95				
Means.	...	...	...	...	...	...	...	...	85·9	75·8	80·8	81·9
Berbice Gardens.												
July ...	14·71	2	2	2	6	1	13	...	86·8	74·7	80·7	83.1
August ...	12·72	2	4	...	8	1	15	...	88·4	74·6	81·5	77.7
September ...	5·69	...	...	1	...	2	3	...	88·7	74·3	81·5	76.8
Totals	33·12	4	6	3	14	4	31	...				
Means.	...	...	...	...	...	...	...	...	87·9	74·5	81·2	79.2
Hosororo, North West District												
July ...	12·50	7	13	5	3	1	29	...	88·1	66·5	77·3	85.9
August ...	8·95	4	13	2	3	...	22	...	89·8	66·1	77·9	85.0
September ...	7·08	7	9	5	1	...	22	...	90·4	65·9	78·1	83.0
Totals	28·53	18	35	12	7	1	73	...	...		...	...
Means.	...	...	...	...	...	...	...	...	89·4	66·2	77·8	84.6

INDEX TO VOL. VI

1935

A

B

C

D

E

F

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

Y